AL.2.2007-224
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ANIELSKI
Management Inc.

Genuine Wealth Assessment of Alberta's Stewardship Programs

FINAL REPORT

Prepared for:

Alberta Environment

July 31, 2007

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ISBN: 978-0-7785-6762-2 (Printed Edition)
ISBN: 978-0-7785-6763-9 (On-line Edition)
Web Site: http://environment.gov.ab.ca/info/home.asp

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1 Executive Summary

This analysis is an accounting of the full range of economic, social and environmental benefits, costs and impacts of Alberta's waste stewardship programs for beverage containers, electronics, tires and used oil materials. This analysis is intended to be used to assess the true societal value of these stewardship programs to Albertans, and to serve as an accounting framework for assessing the sustainability of waste stewardship programs.

This study is the first comprehensive societal and environmental cost-benefit and well-being impact analysis of its kind in Canada for stewardship programs and serves as an important benchmark for evaluating societal returns on investment and long-term sustainability of public policies and programs using the Genuine Progress Indicator (GPI) full-cost-benefit accounting model.[1]

For each of Alberta's four waste stewardship programs, a range of economic, environmental and social costs and benefits were examined. By comparing these costs and benefits, the relative "returns" to societal well-being from investing in these stewardship programs were evaluated.

While the methodology and approach to assessing the four programs are the same, the individual assessments differ slightly depending on the nature of the program under review (years of program operation, materials being processed, program delivery mechanisms, etc.) and data availability. As such, a comparison of results as a means of evaluating the programs is discouraged.

Table 1 below summarizes the overall monetized net marginal benefit (cost) of the programs reviewed. A low, medium and high range is provided. The spread in range of estimates highlights the inherent challenges in valuation exercises. Results including full ranges of the costs and benefits associated with each program, as well as details of the analysis leading to these results, are provided by individual program in the following sections.

Table 1: Net Marginal Benefit (Cost) of Reviewed Programs

	Low estimate	Medium estimate	High estimate
Beverage Containers	**-$61,723,588**	**-$54,301,588**	**-$41,758,588**
Tires	**$5,291,055**	**$20,119,981**	**$35,684,468**
Used Oil Materials	**$17,670,618**	**$19,476,018**	**$21,727,018**
Electronics	**-$2,721,000**	**-$2,032,000**	**-$725,000**

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[1] The GPI full-cost-benefit-accounting model is a subset of the more comprehensive integrated five-capitals Genuine Wealth Accounting model (see www.anielski.com) for measuring the overall well-being and sustainability of communities and organizations.

Table 2 below summarizes the medium estimate of the net marginal benefit (cost) for each of the programs reviewed, as well as a per-capita benefit or cost to Albertans. This per-capita benefit or cost is provided so Albertans can better understand the full societal value they are receiving from these publicly funded programs. As these programs are funded on a user-pay basis, it is important to recognize that the actual cost borne by individual Albertans will vary depending on the extent each consumer uses the products and programs in question.

Table 2: Medium Range Overall and Per-Capita Costs / Benefits

	Beverage Containers	Tires	Used Oil Materials	Electronics
Net Annual Costs / Benefits	**-$54,301,588**	**$20,119,981**	**$19,476,018**	**-$2,032,000**
Net Annual Costs / Benefits per Albertan*	**-$16.67**	**$6.18**	**$5.98**	**-$0.62**

Our analysis shows a range of net societal benefits, measured in economic or monetary terms, produced by Alberta's waste stewardship programs and from the collective effort of households, businesses and government in reducing waste to landfill by recovering and recycling bottles, used oil, electronics and tires. These net marginal benefit (cost) estimates are very likely significantly conservative in nature, as they do not take full account of the aesthetic, civic pride and quality of life benefits that Albertans enjoy as a result. We would conclude that, if these additional benefits were able to be fully quantified, the stewardship program are contributing to a genuine improvement in quality of life for all Albertans on a cost-effective and net societally beneficial basis.

It is important to recognize that cost and benefit categories were only monetized where there was sufficient data available. Categories that were generally not monetized include environmental impacts for which research was not available, disruption in the marketplace, civic pride, and resource conservation and environmental protection. In addition, the overall analytical approach to this study was to err on the side of conservative estimates.

The analysis contained in this study is preliminary and is intended as benchmark for more comprehensive total full cost-benefit accounting of Alberta's waste stewardship programs in the future. The analysis becomes the basis for evaluating the long-term success and sustainability of each of the four programs, and future programs, as each one develops over time. The results of this analysis can help to assess whether these programs are achieving their original desired mission and mandated outcomes.

2 Introduction

Anielski Management Inc. was engaged by Alberta Environment to evaluate through full-cost-benefit and related analyses the overall net societal value of Alberta's Waste Stewardship Programs including programs for i) used oil and oil materials (filters and plastic containers), ii) scrap tires iii) waste electronics, and iv) non-milk beverage containers.

This evaluation was undertaken using the GPI (Genuine Progress Indicator) full-cost-benefit, five-capitals accounting model. The GPI model uses an integrated five-capital accounting framework to measure the physical, qualitative and monetary (full costs-benefits) conditions of human, social, natural, built and economic (financial) capital, which are critical to the well-being of society and to the long-term sustainability of policies, programs and communities. The GPI accounting tool is used to account for the net economic, social and environmental benefits, or costs, and non-monetary impacts of Alberta's used oil, beverage containers, tires and electronics stewardship programs.

2.1 Primary Study Objectives

The primary objectives of this study were to:

1) Validate the overall net social value of each of the four stewardship programs to Albertans in relation to pre-program base-case circumstances.
2) Describe the distribution of costs and benefits among economic sectors and stakeholders within the province.
3) Compare the costs-benefits determination of the Alberta stewardship programs to alternative program approaches/policies in other provincial jurisdictions.
4) Account to Albertans for the true value of and "returns to societal and environmental well-being" of these publicly-funded stewardship programs.
5) To determine the short-term, medium-term and long-term sustainability of these programs.

Key questions to be answered within the analysis included:

1) What are the full range of financial, economic, environmental and social costs and benefits of each of the stewardship programs?
2) What methods and techniques can be employed to valuate them?
3) Which techniques are best suited to assessing the benefits and costs of Alberta's programs.
4) What is the expected accuracy of the resulting valuations?
5) What are the appropriate options for base case (counterfactual) comparisons for the cost-benefit analysis? How are they derived? (i.e., waste management practices in Alberta prior to program implementation and/or what would have otherwise occurred in Alberta for the management of these wastes had the programs not been implemented.)

6) To what extent do the programs (individually and collectively) provide a net marginal benefits (costs) to Albertans?
7) How reliable are the estimates of benefits and costs and describe the risks and uncertainties associated with the individual benefit and cost elements?
8) What is the distribution of costs and benefits among various economic sectors and stakeholders within the province?
9) Are there significant equity or fairness issues among stakeholders or sectors?
10) What are alternative program/policy approaches to managing the four waste streams that are being carried out in other provincial jurisdictions, and have benefit/cost or other economic evaluations of their programs been undertaken?
11) Are the methods used to evaluate the alternative approaches directly comparable with the benefit/cost evaluation of the Alberta programs?
12) How do Alberta's programs compare to these alternatives on a cost-benefit basis?

This study appears to be the first comprehensive societal and environmental full-cost-benefit analysis of its kind in Canada for recycling programs. The only comparable study was a full cost-benefit analysis of Nova Scotia's waste-resource management system (*The Nova Scotia GPI Solid Waste-Resources Accounts*) completed in 2004 by GPI Atlantic.

The study establishes an important benchmark for conducting even more rigorous full economic, social and environmental evaluation of returns on investment and long-term sustainability of public policies and programs using the GPI full-cost-benefit accounting model.

This report complements the Bearing Point International Study, also commissioned by Alberta Environment, that compares the effectiveness and cost-effectiveness of Alberta's DAO stewardship programs with similar programs in other jurisdictions in Canada and internationally.

2.2 Study Approach

The study uses the GPI (Genuine Progress Indicator) full-cost-benefit accounting tool, referred to as simply "GPI accounting", for evaluating the net societal benefits (or costs) of public policies or programs. The GPI accounting tool is a subset of the integrated, five-capitals Genuine Wealth societal well-being and sustainability measurement model.[2] A detailed discussion of the GPI accounting model is included in Appendix A.

This study of Alberta's stewardship programs uses a similar approach to previous GPI studies conducted in Alberta by the Pembina Institute, and builds on the lessons learned in the GPI Atlantic study of the full cost-benefits of Nova Scotia's waste-resource management system.

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[2] The Genuine Wealth model for measuring community sustainable well-being and the GPI full-cost-accounting framework for Alberta were developed by economist Mark Anielski of Anielski Management Inc (www.anielski.com).

The GPI accounting framework for Alberta's stewardship programs can be broken down according to "benefits" and "costs" to societal well-being. The **benefits** side of the GPI "income statement" would include the following attributes:

- Value of recovered materials in end markets.
- Reduced landfill development and operational costs
- Reduced environmental contamination and associated health risks of environmental impairment
- Reduced environmental risks
- Reduced costs of extraction/processing of virgin materials for products
- Overall value of a cleaner / healthier environment
- Employment benefits of a growing recycling industry
- Avoided greenhouse gas emissions and air pollutants
- Resource conservation
- Increased employment
- Economic spin-offs such as tourism
- Reduced liability
- Energy savings

The **costs** to be examined include the following:

- Program administrative and operational costs (direct and indirect)
- Costs to government in the oversight role of Stewardship Programs
- Costs to other parties (i.e., retail sector to collect eco-fees, public/household participation)
- Any increased environmental impacts associated with the programs
- Disruptions to the marketplace
- Operating and amortized capital costs, including costs associated with collection, transportation, storage, recycling, reuse, and recovery of materials
- Reduced employment
- Nuisance or increased risk management costs
- Energy use
- Other unaccounted environmental and social costs
- The analysis will include the following elements:

A range of costs and benefits were then examined from using low (conservative), medium (average), and high (liberal) estimates. By comparing these costs and benefits of Alberta's stewardship programs, on a gross, per Albertan, and per unit of material recycled, basis, the relative "returns" to Albertans from investing in these stewardship programs can be evaluated.

The analysis is intended to provide Albertans with a clearer account of the full value they are receiving from stewardship programs for beverage container, used oil material, tire and electronic equipment and the cost-efficiencies by which they are operating. The analysis helps evaluate the success and sustainability of these programs in terms of keeping Alberta's environment clean and resulting in at least no net loss in environmental and societal well-being. The results can also to help assess whether these programs have achieved their mandated outcomes.

3 Methodology

Using the GPI accounting model (see Appendix A), the life-cycle of physical flows and relationships within Alberta's stewardship programs were mapped, measured and evaluated, as well as the respective monetary (costs and benefits) attributes of those flows. For example, Figure 1 provides an example using Alberta's Tire Recycling Program that shows the various operating attributes of the program, their interrelationships and both monetary and non-monetary benefits and costs.

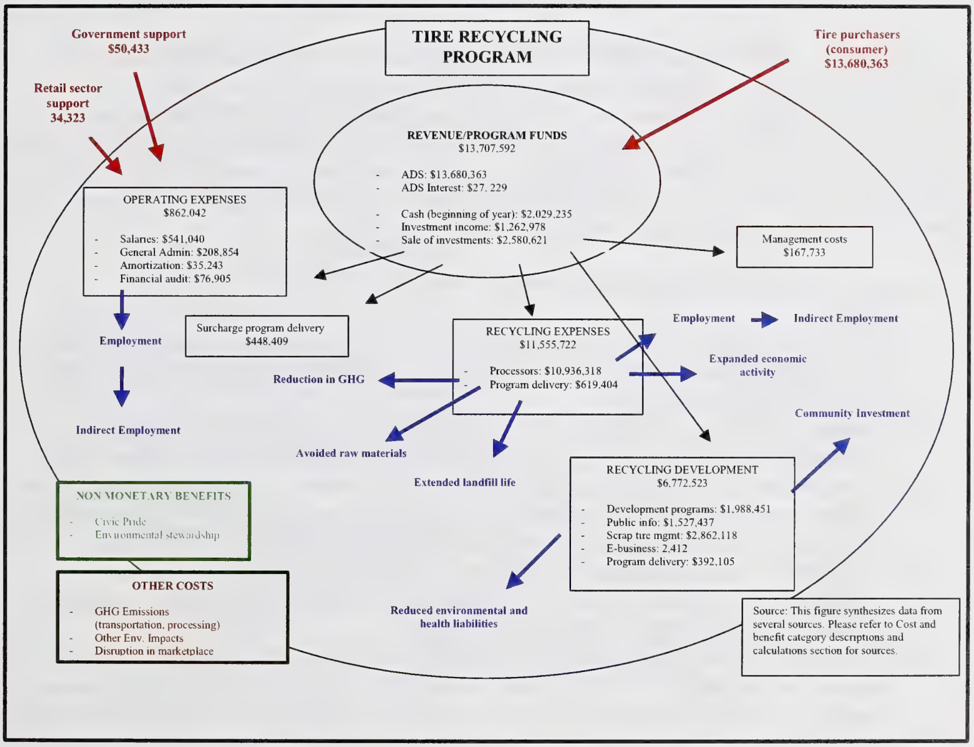
TIRE RECYCLING PROGRAM
Government support $50,433
Retail sector support 34,323
Tire purchasers (consumer) $13,680,363
REVENUE/PROGRAM FUNDS $13,707,592
- ADS: $13,680,363
- ADS Interest: $27, 229
- Cash (beginning of year): $2,029,235
- Investment income: $1,262,978
- Sale of investments: $2,580,621
OPERATING EXPENSES $862,042
- Salaries: $541,040
- General Admin: $208,854
- Amortization: $35,243
- Financial audit: $76,905
Management costs $167,733
Surcharge program delivery $448,409
Employment
Indirect Employment
RECYCLING EXPENSES $11,555,722
- Processors: $10,936,318
- Program delivery: $619,404
Employment
Indirect Employment
Expanded economic activity
Reduction in GHG
Avoided raw materials
Extended landfill life
Community Investment
RECYCLING DEVELOPMENT $6,772,523
- Development programs: $1,988,451
- Public info: $1,527,437
- Scrap tire mgmt: $2,862,118
- E-business: 2,412
- Program delivery: $392,105
Reduced environmental and health liabilities
NON MONETARY BENEFITS
- Civic Pride
- Environmental stewardship
OTHER COSTS
- GHG Emissions (transportation, processing)
- Other Env. Impacts
- Disruption in marketplace
Source: This figure synthesizes data from several sources. Please refer to Cost and benefit category descriptions and calculations section for sources.

Figure 1: Tire Recycling Program Map

3.1 Identification of Financial, Economic, Environmental and Social Costs And Benefits of Each of the Stewardship Programs

The GPI assessment attempts to identify the widest possible suite of financial, economic, environmental and social attributes or impacts (costs and benefits) associated with the DAO stewardship programs. Attempts were made to measure both the physical (qualitative analysis) and monetary (full-cost-benefit analysis) characteristic of these impacts.

In some cases monetary estimates were not available, due to the lack of data or the inherent difficulty in monetizing social and environmental costs or benefits (i.e., intangible costs and benefits). In these cases, a description and assessment of their impacts (positive and negative) on societal well-being must suffice. Reasons for not assigning a monetary value include a lack of data to confidently assign a value, infancy of the program or simply an acknowledgement that some non-traditional costs and benefits cannot adequately be valued in any meaningful way.

Categories that were generally not monetized include:

- Environmental impacts for which research was not complete or readily available. For example, the environmental impacts associated with production of molded products from rubber crumb.
- Disruption in the marketplace – this includes the cost of pure free market inefficiencies which may result from barriers to marketplace entry of new firms; for example, controlled or regulated prices, grandfathered benefits for early market entrants, and regulations mandating that programs are consistent throughout the province. These barriers and market inefficiencies are difficult to monetize.
- Civic pride – it is well-recognized that environmental programs and citizen participation contribute to a feeling of pride in the community, however, assigning a value to this societal benefit is very difficult.
- Resource conservation / environmental protection – environmental benefits resulting from efforts such as Alberta's stewardship programs extend far beyond greenhouse gas reductions and landfill savings. Related impacts, such as habitat conservation and improved air quality, are very difficult to quantify in correlation to these specific programs.

Table 4 lists costs and benefits that were considered when reviewing Alberta's stewardship programs.

Table 3: Summary of Costs and Benefits of Considered

Costs:
Program operating costs

Government support

Industry/retailer support

Collection/transport (if separate from operating costs)

Processing/recycling (if separate from operating costs)

Household support
Surcharge/levy
Time
Transportation

Disruption in marketplace
Reduced competition
Employment loss

Environmental costs
GHG emissions - transportation
GHG emissions - processing
Other environmental impacts

Benefits:
Resource recovery benefits
Reduction in GHG emissions
Avoided raw material use
Energy savings
Extended landfill life incl. delayed landfill life siting costs
Reduced environmental and human health liability
Reduced litter

Employment
Direct employment
Indirect employment

Expanded economic activity / opportunity

Community benefits
Community investment
Civic pride

Environmental stewardship
Resource conservation and environmental protection

3.1.1 Costs and Benefits Valuation

For cost and benefit categories in which we attempted to attach a monetary value, a low, medium and high range is estimated for each category (see Table 4 for an example of monetized categories that were assessed for the tire stewardship program). A spread of values is provided recognizing the inherent challenges in valuation exercises.

Table 4: Summary of Monetized Costs and Benefits

Recycling Program Costs and Benefits (fiscal year 2004-2005)			
COSTS	**Low**	**Medium**	**High**
Program operating costs			
Recycling incentives			
Administration incl. amortization			
Recycling development and promotion			
Government support			
Retail sector program support			
Disruption in marketplace			
Total Costs			
BENEFITS	**Low**	**Medium**	**High**
Reduction in GHG emissions			
Avoided raw material use			
Extended landfill life			
Avoided siting and operational costs			
Reduced environmental and human health liability			
Direct employment			
Indirect employment			
Expanded economic activity			
Community investment			
Total Benefits			

For each program a summary of the monetized costs and benefits are provided indicating if the program resulted in a net marginal benefit (cost) to Albertans. This gross GPI full-cost-benefit analysis is based on comparing estimated program costs against our estimates of program benefits. Results are also presented on a net marginal benefit (cost) per unit equivalent recycled (e.g., per tire or beverage container) and on a per Albertan basis.

3.1.2 Monetary and Physical Description of Cost and Benefit Categories

The GPI analytic framework accounts for both the physical and qualitative impacts and monetary value for each cost or benefit category. Both monetary and physical units of measurement can be expressed in gross value terms or on a per unit material recycled basis. For each program a summary table is included which highlights the physical, qualitative and monetary impacts of each of the waste stewardship programs. Included within these summary tables is a column identifying who bears the costs and who receives the benefits being described. The intention of this column is to highlight the issue of distribution of costs and benefits.

Table 5: GPI Physical, Qualitative and Monetary Impacts

Genuine Wealth Analysis	Monetary	Monetary / unit	Physical	Who bears costs / receives benefit
Source of Revenue			***Number of total units or equivalents that was recycled.***	Consumer
Pre-program comparison: tires, bottles, used oil and filters, electronics sent to landfill.				
Costs				
Program operating costs				
Government costs				
Retailer costs				
Environmental impacts				
Disruption in marketplace				
Benefits				
Reduced costs resulting from resource recovery				
Employment / Economic				
Expanded Economic Activity/ Opportunity			New markets, stimulus for innovation	Economy/ public good
Community benefits				
Environmental stewardship				

3.2 Valuation Techniques Used Within the Model to Assess Costs and Benefits

Various economic and financial valuation methods are used in GPI assessment of the costs and benefits of Alberta's stewardship programs (methods are discussed within each cost or benefit analysis section of the report). These range from tangible (monetized) to intangible (non-monetized) costs and benefits.

Tangible benefits or costs are those in which a market value has been revealed. The most straightforward "tangible" cost estimates are program operating and capital costs, which are derived from the financial statements of the DAO. An example of an estimated tangible benefit is the market value of direct employment benefits related to the recycling industry derived by estimating the market value of labour employed in the sector. Less tangible benefits include the estimated value of reductions in greenhouse gas emissions; here a range of values (low, medium, and high) are used, since there may be no definitive market values for carbon. For example, this is the case in North America, while a carbon market (CO_2 emissions trading) exists in Europe, revealing current market values.

A few intangible benefits have been identified which fall into the categories of public goods or environmental quality. These include the value of increased civic pride resulting from public involvement in recycling programs and the resulting cleaner environment. Also, the value of improved resource conservation and environmental protection resulting either directly or indirectly from the stewardship program cannot be monetized directly, yet does result in a public good or environmental benefit. In these cases we have simply described these benefits (or costs).

3.2.1 Accuracy of Resulting Valuations

The accuracy of our results depends ultimately on the accuracy of the original source of the physical and monetary data. The accuracy of both physical flow accounting and reporting of operating expenditures and revenues is critical. The GPI assessment was designed to ensure a transparent and accurate accounting using the best available public data sources and clear valuation assumptions. The analysis is meant to allow for refinement as new or more accurate data becomes available and as measurement techniques are improved.

We believe the analysis presented in this report reflects the most accurate and available data at this time, though we recognize that there will be data gaps and possibly conceptual challenges. Regular consultation with experts within the DAOs and from the recycling industries occurred throughout the project to ensure accuracy of information and the reasonableness of the assumptions, methods and evaluations conducted.

Users of the GPI assessment results and those more familiar with the details of Alberta's stewardship programs are encouraged to challenge the data sources and measurement assumptions so that the integrity of this system of well-being measurement can be maintained.

The greatest challenge in this analysis was the capacity to provide an accurate account of the counterfactual scenario, pre-program analysis and analysis of what would exist today without the stewardship programs in place. In many cases, data was not available, requiring assumptions or proxies within the analysis.

Discounting was also considered, and this issue is discussed in detail in Appendix B.

4 Beverage Containers

4.1 Review of Costs and Benefits

In 2004, from a purely bottom line economics perspective having a beverage container recycling system in Alberta costs roughly $70 million. The money to drive the program comes from unredeemed deposits, container recycling fees, and the money generated through the sales of recycled beverage containers to commodity markets. The beverage container program at a glance is a staggering initiative. 1.6 billion beverage containers were sold in the province. 1.3 billion beverage containers were recovered. $22.6 million was generated through the sale of recovered materials.

Beyond the more readily apparent system costs and the tangible result of recovering 1.3 billion beverage containers, there are several other costs and benefits associated with the beverage container stewardship program which are not readily apparent from a traditional bottom line economic analysis. A simple review of the beverage container recovery system for the 2004 year highlights many non-traditional costs and benefits associated with recovering beverage containers.

Consumers pay a deposit on the purchase of all beverage containers in Alberta with the exception of milk containers. Deposits range from 5 cents to 20 cents per container depending on beverage container size. Containers are categorized into 18 different groups based on material type and size. In addition, consumers pay a container recycling fee (CRF), that varies according to container type. The fee is set based on the amount of money it takes to support the recovery costs of a specific container type. Attempts are made to minimize cross-container subsidization within the program. For example, monies generated through unredeemed deposits on aluminum cans and the sale of aluminum cans to commodity markets are not used to support the recovery and recycling of HDPE plastic containers.

Cost – 1: **Increased cost burden to consumers of Container Recycling Fee (CRF).**

Cost – 2: **Administration costs incurred by retailer (collecting deposits, and CRFs, additional bookkeeping work). *Note: deposits and CRFs are charged up-front on the bill from the manufacturer, so there is no after-the-fact calculating and remitting.***

Beverage manufacturers and distributors in turn remit deposits and CRFs to one of two collection system agents – either the Alberta Beverage Container Recycling Corporation (ABCRC) or the Alberta Beer Container Corporation (ABCC). Manufacturers also pay a product registration fee to the Beverage Container Management Board (BCMB).

Cost – 3: **Increased costs to manufacturers/distributors (administrative costs associated with remitting deposits to collection system agents and product registration costs).**

The beverage container stewardship program is overseen by the Beverage Container Management Board. BCMB is a delegated administrative organization (DAO) made up of beverage manufacturers, depot operators, environmental organizations, municipalities, the public and the Alberta Government. BCMB is mandated to administer the system. Responsibilities include: setting criteria for the system; conducting depot and retail inspections; registering new beverage containers; issuing operating permits for container depots; approving collection system agents, and maintaining a system of appeals.

Cost – 4: **Disruption to marketplace. Criteria set by BCMB restrict access to marketplace and flexibility within system.**

Cost – 5: **Decreased expenditure in other economic sectors due to investment in beverage container recycling program.**

Cost – 6: **Government oversight costs incurred by supporting the beverage container stewardship program.**

Benefit – 1: **Employment (BCMB)**

BCMB itself is not directly involved with the collection of beverage containers or collecting and remitting deposits or container recycling fees, nor is it directly involved with the processing and resale of containers for reuse or recycling. This is done by one of two collection system agents, the Alberta Beverage Container Recycling Corporation (ABCRC) or the Alberta Beer Container Corporation (ABCC). ABCRC is responsible for non-beer beverage containers, while ABCC is responsible for all beer containers. However, ABCC has chosen to contract collection of import beer containers to ABCRC. In 2004, 66% of the total beverage containers sold in Alberta fell under ABCRC's mandate while ABCC was responsible for 34%.

ABCRC is a not-for-profit industry driven stewardship corporation which is responsible for managing the system that collects and recycles empty registered beverage containers (other than domestic beer containers) from bottle depots on behalf of manufacturers who sell beverages in Alberta. All manufacturers and distributors of registered beverages are required to participate in the common collection system if they wish to sell or distribute beverages in containers in Alberta.

The Alberta Beer Container Corporation (ABCC) represents brandowners of beer sold in Alberta and is the agent responsible for the collection of beer containers. ABCC, in turn, subcontracts the administration of deposits and remittances to depot operators, collection and processing of beer cans and bottles to Brewers' Distributor Limited (BDL). In addition to collecting beer containers for recycling, they also redistribute industry standard bottles back to brand owners for reuse.

Both ABCRC and ABCC collect materials from depots.

Cost – 7: **GHG emissions associated with transportation, including transportation of beverage containers from depots to centralized processing facilities and from processing facilities to commodity markets.**

Cost – 8: **GHG emissions associated with processing empty beverage containers.**

Cost – 9: **Other environmental impacts associated with recycling and reusing beverage containers including air pollution and water pollution.**

Benefit – 2: **Employment (ABCRC, ABCC, BDL)**

Benefit – 3: **GHG reductions resulting from recycling and reusing beverage containers.**

Benefit – 4: **Reductions in air and water pollution achieved by recycling and reusing empty containers.**

Benefit – 5: **Extended landfill life by not disposing of beverage containers in landfills.**

Benefit – 6: **Energy savings gained by recycling beverage containers as opposed to using virgin material feedstocks.**

Benefit – 7: **Reduced municipal waste collection costs by diverting material from regular waste stream.**

Benefit – 8: **Increase in civic pride associated with being a leader in recycling.**

Benefit – 9: **Other benefits associated with investment in stewardship programs, including resource conservation and environmental protection benefits.**

Benefit – 10: **Support for non-profit organizations through the 'Community Champions Program'.**

Empty beverage containers can only be redeemed for deposit at registered depots. There are 216 universal depots in Alberta and 78 class D beer depots. Class D beer depots collect beer containers only. Depots are required to accept all beverage containers sold in the province (with the exception of milk containers) and redeem the full deposit which was paid at the point of sale. Depots are also required to sort and store containers until pick up by ABCRC or ABCC.

Collection system agents reimburse depot operators for the deposits paid out. In addition, collection system agents pay depot operators a handling commission to compensate them for recovering and temporarily storing containers. Handling commissions range from 2.8 cents to 8 cents per container depending on the product.

Cost – 11: **Time costs incurred by households to sort, store, and return empty containers to depots.**

Cost – 12: **Transportation costs incurred by households to return empty beverage containers.**

Cost – 13: **Financial costs to consumers through unredeemed deposits**

Benefit – 11: **Employment (depots).**

Benefit – 12: **Reduced litter by encouraging the recovery of containers through fully refunded deposits.**

Benefit – 13: **Economic opportunity for unofficial container collectors (i.e., bottle collectors).**

4.2 Context of Analysis

This analysis captures the costs and benefits of the beverage container stewardship program for the 2004 year. While there are risks in taking a static, single operating year perspective, we are confident that this is not an abnormal operating year given the maturity of the program and the consistency in revenues, expenditures, and return rates over past operating years.

This analysis also compares several key costs and benefits of the current system with a potential curbside 'blue box' program for Alberta. We explore two different alternative scenarios: an aggressive program based on a 99% access to curbside recycling, and a moderate program based on a collection system where approximately 95% of the population has access to recycling opportunities, through a combination of curbside (~40%) and drop-off (~60%) recycling.

4.2.1 Cost and Benefit Categories

While this analysis attempts to attribute a monetary value to all categories, in several cases due to the lack of data or the inherent difficulty in monetizing social and natural capital, we describe the cost or benefit only. For a more detailed description of costs and benefits including how dollar values were estimated see Section 4.5.

Table 6 lists the costs and benefits and the associated evaluation methods of categories included in this review of the beverage stewardship program. For a list of all categories considered see Section 3.1 and Table 3.

Table 6: Summary of Costs and Benefits of Beverage Container Stewardship Program

	Evaluation Method	
COSTS:	**Monetary**	**Description**
Program delivery costs		
BCMB	✓	✓
ABCRC	✓	✓
ABCC	—	✓
Depots (universal)	✓	✓
Government costs		
Government support	✓	✓
Industry support		
Container levies	✓	✓
Product registration fees	✓	✓
Household support		
Unredeemed deposits, CRFs	✓	✓
Household time	✓	✓
Household transportation	✓	✓
Environmental costs		
GHG emissions - transportation	—	✓
GHG emissions - processing and manufacturing	—	✓
Other environmental impacts	—	✓
Disruption in marketplace		
Reduced competition	—	✓
BENEFITS:		
Resource recovery benefits		
Reduction in GHG emissions	✓	✓
Energy savings	✓	✓
Extended landfill life incl. delayed landfill life siting costs	✓	✓
Reduced litter	—	✓
Employment		
Direct employment	✓	✓
Indirect employment	✓	✓
Community benefits		
Community organization support	✓	✓
Civic pride	—	✓
Economic opportunity (unofficial container collectors)	—	✓
Environmental stewardship		
Additional resource conservation and environmental protection	—	✓

4.2.2 Categories Not Monetized

Where feasible we attempted to attach a monetary value to the costs and benefits explored in this analysis of the beverage container stewardship program. A low and high range is estimated for each category. Where possible, a medium range is also provided, whether through an alternate moderate estimate, or as an average of low and high values. The spread in range of estimates highlights the inherent challenges in valuation exercises.

Several cost and benefit categories included in the Genuine Wealth analysis were not monetized in our review of the beverage container stewardship program. This was either due to a lack of data to confidently assign a value or simply an acknowledgement that some non-traditional costs and benefits cannot adequately be valued in any meaningful way.

Categories not monetized include:

- ABCC program support
- Disruption in the marketplace
- Environmental costs (GHG costs are included in overall net GHG benefit only)
- Civic pride
- Economic opportunity (unofficial container collectors)
- Resource conservation / environmental protection

A summary of the monetized costs and benefits of the beverage container stewardship program are provided in Table 7. We assessed the direct costs and benefits of the program in 2004. Results are expressed in aggregate form (total costs and benefits), on a per capita basis and on a per container basis.

Table 7: Summary of Monetized Costs and Benefits

Beverage Container Program Costs and Benefits (fiscal year 2004-2005)			
Program Operating Funds*			
Unredeemed deposits ($ left in system)	$20,489,385		
Container recycling fee	$26,645,752		
Product registration fee	$50,357		
Container levy (manufacturers)	$596,889		
Sales of recovered containers	$22,598,099		
Total Funds	**$70,380,482**		
	Low	**Medium**	**High**
Program Operating Costs			
Program operating costs*	$70,380,482	$70,380,482	$70,380,482
Other Non-Program Societal Costs			
Government support	$16,106	$16,106	$16,106
Industry support	$650,000	$650,000	$650,000
Household time	$35,500,000	$42,130,000	$48,760,000
Household transportation	$3,696,000	$7,391,000	$14,783,000
Disruption in marketplace	not quantified	not quantified	not quantified
Total Program Costs	**$110,242,588**	**$120,567,588**	**$134,589,588**
Beverage containers recycled (04-05 fiscal year): 1,327,788,002			
Program operating costs per container recycled	$0.05	$0.05	$0.05
Total program costs per container recycled	$0.08	$0.09	$0.10
	Low	**Medium**	**High**
Societal Benefits			
Reduction in GHG emissions	$2,740,000	$8,625,000	$14,408,000
Extended landfill life	$13,924,000	$17,405,000	$21,234,000
Avoided siting costs	$54,000	$134,000	$214,000
Energy savings	$23,295,000	$27,176,000	$31,056,000
Reduced litter	$788,000	$1,069,000	$1,350,000
Water Conservation	$1,021,000	$1,463,000	$1,905,000
Direct employment	$3,226,000	$5,049,000	$11,010,000
Indirect employment	$3,457,000	$5,411,000	$11,800,000
Community investment	$68,000	$68,000	$68,000
Total Societal Benefits	**$48,519,000**	**$66,266,000**	**$92,831,000**
Net Annual Costs/Benefits	**-$61,723,588**	**-$54,301,588**	**-$41,758,588**
Net Annual Costs/Benefits per Albertan**	**-$18.95**	**-$16.67**	**-$12.82**
Net Annual Costs/Benefits per container	**-$0.05**	**-$0.04**	**-$0.03**

* To determine the overall cost to operate the beverage container stewardship program we assumed it was equivalent to the money entering the system and not exiting the system (deposits paid out). The assumption

was that the money which stays in the system is the total amount of $ supporting the beverage container recycling program in 2004. This includes unredeemed deposits, container recycling fees, product registration fees, container levies, and monies generated through the sale of recycled containers.
**Assumes a population of 3,256,800. Although this is an average per-capita cost, it is important to note that this is a user-pay program, and as such, the amount paid by individuals varies based on their purchase of beverage containers and their participation in the program.

***Sources*: This summary table synthesizes data from several tables. Please refer to tables in the costs and benefits description section for sources.**

The bottom line, based on a full cost accounting perspective, and including all monetized categories, is that the beverage container stewardship program operated within a range of **a net cost of $42 million $62 million. This equals a per-container recycled cost range of 3-6 cents.**

4.3 Monetary and Physical Description of Cost and Benefit Categories

In addition to attributing a monetary value to cost and benefit categories, this analysis summarized in Table 8 also provides a physical description for each category. Please note that this table is not a cost/benefit summary table. Row results are not commensurable and should not be added. Monetary estimates and monetary estimates per container speak only to the line item which they reference. A detailed description of each of these line items is provided in Section 4.5. Table 7 (above) provides a summary of the costs and benefits.

Table 8: Cost-Benefit Analysis – (2004) (Monetary and Physical)

Genuine Wealth Analysis	Monetary	Monetary / container	Physical
Revenue (incl. **BCMB, ABCRC, ABCC***)			
Unredeemed deposits	$20,489,385	$0.015	326,095,261 containers not recovered deposit rate: 5-20 cents
Container recycling fee	$26,645,752	$0.020	0-8 cents per container
Container levy (manufacturers)	$596,889	$0.000	
Product registration fee	$50,357	$0.000	
Sales of recovered containers	$22,598,099	$0.017	
Total	**$70,380,482**	**$0.053**	**1,653,883,263 containers sold** **1,327,788,002 containers recovered**
Costs			
Program costs			
BCMB	Operating expenses: $872,963	$0.00	
ABCRC	$48,823,863 Depot commissions/ handling fees: 77% Operating costs: 22% BCMB fee: 1%	$0.058**	1,135,438,227 containers sold > 840,725,200 containers processed (74%) – Aluminum: 385,454,600 – Plastics: 224,338,600 – Glass: 138,694,900 – Polycoat: 89,138,000 – Bi-metal: 3,099,100
ABCC	Handling fees (to depots): ~$13,600,000 BCMB fee: ~$216,000	Not available	518,445,036 containers sold > 480,786,192 containers processed (94%) – Aluminum: 316,553,556 – Glass: 164,232,636
Universal Depots	Operating expenses: $30,960,014 Labour: $20,325,087 Container levy: $596,246	$0.030***	
Industry support			
Container levy	$596,246	$0.000	Paid on all containers
Product registration fee	$50,357	$0.000	Paid on all new products sold in the province
Government support	$16,106	$0.000	On-going support days: 24 days/year

Genuine Wealth Analysis	Monetary	Monetary / container	Physical
Household costs			
CRF	$26,645,752	$0.020	0-8 cents per container
Unredeemed deposits	$20,489,385	$0.015	~326,095,250 containers not recovered deposit rate: 5-20 cents
Transportation	$3,696,000 - $14,783,000	$0.003 - $0.011	Up to 41,063,086 km Up to 4,927,570 litres/gasoline
Time	$35,500,000 - $48,760,000	$0.027 – $0.37	2.2 hours/year/household
Disruption in marketplace			
Regulated market			
Decreased competition			
GHG costs			
GHG emission costs related to transportation			ABCRC & ABCC: 10,975 tonnes of eCO_2 Households: 12,910 tonnes of eCO_2
GHG emissions related to processing and recycling costs			
Benefits			
Reduced costs resulting from resource recovery			
Reduction in GHG emissions	$2,740,000 - $14,408,000 ($27/tonne - $142/tonne)	$0.002 - $0.011	Net reduction: (110,878) tonnes of eCO_2 – Aluminum: (63,883) tonnes of eCO_2 – PET: (24,947) tonnes of eCO_2 – Glass reused: (13,756) tonnes of eCO_2
Extended landfill life	$13,924,000 - $21,234,000 (low - $29/m^3 ; medium - $31.90/m^3; high - $34.80/m^3)	$0.011 - $0.016	348,104 yd^3
Avoided siting and operational costs	$54,000 - $214,000 ($0.60/tonne - $2.37/tonne) Values are included in extended landfill life benefit		90,167 tonnes
Energy savings	$23,295,000 - $31,056,000	$0.018 - $0.024	337,763 – 450,289 barrels of oil
Reduced litter	$788,000 - $1,350,000	$0.0006 0 $0.001	A reduction of 11.8 million containers
Air and water pollution			
Water conservation	$1,021,000 - $1,905,000	$0.001	2 billion litres of water savings

Genuine Wealth Analysis	Monetary	Monetary / container	Physical
Employment / Economic			
Direct employment	$3,226,000 - $11,010,000	$0.002 - $0.008	Jobs supported: 2,065
Indirect employment	$3,457,000 - $11,800,000	$0.003 - $0.009	Jobs supported: 2,684 jobs
Community benefits			
Community investment	$68,000	$0.000	1 million container returned as part of Community Champions Challenge
Civic pride			
Environmental stewardship			
Resource conservation and environmental protection			

* This amount does not include monies generated by ABCC through the sale of recovered bottles back to domestic beer manufacturers.
** Per container processed by ABCRC.
***Per container returned to universal depot.

***Sources*: This summary table synthesizes data from several tables. Please refer to tables in the costs and benefits description section for sources.**

4.4 Material and Monetary Flow Analyses

Figure 2 provides a schematic overview of how money and materials flow through the larger beverage container stewardship system. Figure 2 also depicts the relationship among the stakeholders involved with the beverage container stewardship program to better understand who bears the costs and benefits of the program.

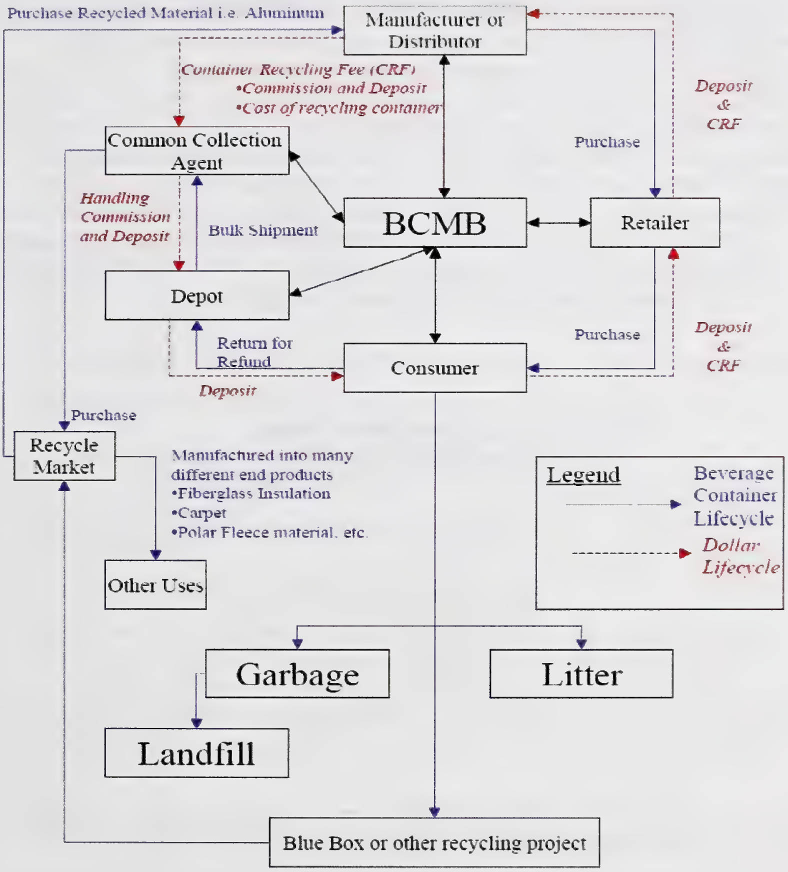
Purchase Recycled Material i.e. Aluminum
Manufacturer or Distributor
Container Recycling Fee (CRF)
•Commission and Deposit
•Cost of recycling container
Deposit & CRF
Purchase
Common Collection Agent
Handling Commission and Deposit
Bulk Shipment
BCMB
Retailer
Depot
Return for Refund
Purchase
Deposit & CRF
Consumer
Deposit
Purchase
Recycle Market
Manufactured into many different end products
•Fiberglass Insulation
•Carpet
•Polar Fleece material, etc.
Other Uses
Legend
Beverage Container Lifecycle
Dollar Lifecycle
Garbage
Litter
Landfill
Blue Box or other recycling project

Figure 2: Material and Monetary Flow Analysis

Source: Stantec, 2005: p.2

4.5 Full Cost and Benefit Category Descriptions and Calculations

This section reviews each item included in the full cost and benefit analysis providing a description of each category. If a monetized value was estimated for the category, an explanation of how the monetized value was estimated is provided.

4.5.1 Costs of Beverage Container Stewardship Program

Program delivery of the beverage container stewardship program involves four main stakeholders including the Beverage Container Management Board, the Alberta Beverage Container Recycling Corporation, the Alberta Beer Container Corporation and the depot operators. While not directly involved in program delivery, several other stakeholders play a key role in supporting the system. These include beverage manufacturers, beverage retailers, the government and consumers. Figure 3 reviews the major stakeholders. The nature of their support is discussed in the following sections. In addition to highlighting the cost incurred by the identified stakeholders, this analysis looks at the cost of implementing a beverage container recycling program has on the market place and discusses costs of recycling and processing beverage containers.

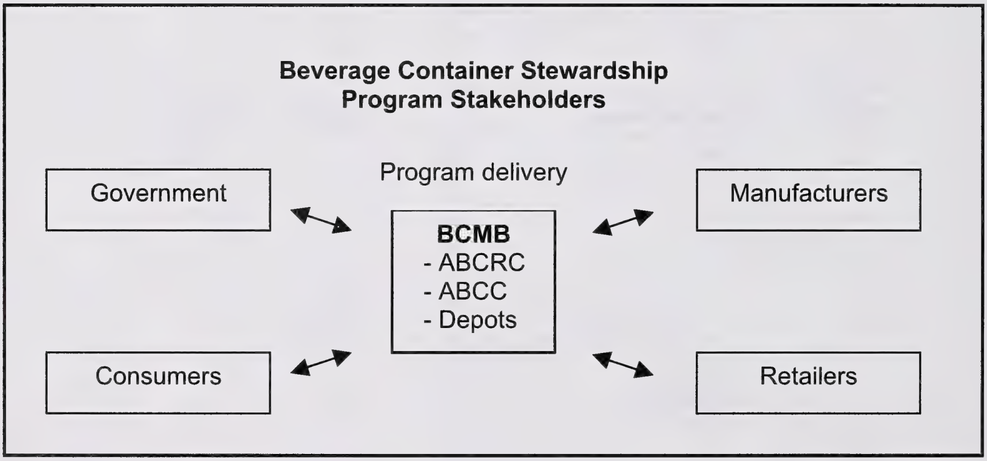

Figure 3: Beverage Container Stewardship Program Stakeholders

4.5.2 Program Delivery Costs

The direct dollars supporting the beverage container stewardship program totaled $70 million dollars (see Table 9). This includes money left in the system in the form of unredeemed deposits, container recycling fees, product registration fees, and the sale of recovered containers. Missing from this amount is the value of recovered bottles sold from ABCC back to domestic beer manufacturers.

Table 9: Direct Funding of the Beverage Container Stewardship Program

Source	$ (2004)
Unredeemed deposits ($ left in system)	$20,489,385
Container recycling fee	$26,645,752
Product registration fee	$50,357
Container levy (manufacturers)	$596,889
Sales of recovered containers	$22,598,099
Total	$70,380,482

Source: ABCRC, 2005; BCMB, 2005.

While $170 million dollars flowed into the system, almost $100 million exited the system in redeemed deposits by consumers. Roughly 70 million, therefore, stayed within the system.[3] We assume that the money staying in the system is a good indication of the dollars that were required to support the beverage container recycling program in 2004. This amount, however, is not necessarily the combined amount of money that was spent on program operations. Some money could have been placed in reserve or past reserves money could have been accessed to support the program.

- ***Program delivery costs: $70,380,482***
- ***Per container equivalent costs: $0.053***

The following sections look in detail at the operating costs and generally at revenue and expenditure data of BCMB, ABCRC, ABCC and the depots to better understand the program delivery costs.

4.5.3 Beverage Container Management Board

The management of post consumer beverage containers is overseen by the Beverage Container Management Board (BCMB). BCMB is a delegated administrative organization (DAO) made up of beverage manufacturers, depot operators, environmental organizations, municipalities, the public and the Alberta Government. The 12 member board is mandated to oversee and facilitate the collection and recycling of beverage containers.

Specific responsibilities include:

- Setting criteria for the system
- Conducting depot and retail inspections
- Registering new beverage containers
- Issuing operating permits for container depots
- Approving collection system agents
- Maintaining a system of appeals

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[3] This amount does not include monies generated by ABCC through the sale of recovered bottles back to domestic beer manufacturers.

BCMB is funded through the collection of product registration fees and a container fee levy based upon the returns of beverage containers. For every beverage container that is returned, each of the manufacturers and the depots pay a container levy of $0.00045. Total revenues in 2004 were $1.27 million dollars. 94% was generated by levies collected on container fees. Table 10 highlights BCMB revenues by category.

Table 10: BCMB Revenues (2004$)

Revenue (2004)		% of Total Revenues
Container fees	$1,193,779	94.0%
Product registration fees	$50,357	4.0%
Interest and other	$18,249	1.4%
Depot fees	$7,848	0.6%
Total Revenues	**$1,270,233**	100.0%

Source: BCMB, 2005.

BCMB total expenditures in 2004 were $1.16 million. This includes operating costs of $873,000 and project costs of $282,000. Table 11 highlights BCMB expenditures by category. 45% of the operating costs went to payroll followed by legal fees and office lease totaling 11% and 10% of total operating costs respectively.

Table 11: BCMB Expenditure (2004$)

Expenditures (2004)		**% of Total Operating Expenditures**
Payroll	$394,725	45.2%
Legal fees	$95,031	10.9%
Office	$90,786	10.4%
Advertising	$63,164	7.2%
Directors honoraria and expense	$46,164	5.3%
Travel	$41,598	4.8%
Refund compliance	$40,055	4.6%
Appeals committee	$33,584	3.8%
Depreciation	$21,639	2.5%
Other professional fees	$16,952	1.9%
Insurance and licenses	$11,377	1.3%
Audit fees	$6,900	0.8%
Staff training	$3,769	0.4%
Judical review	$2,485	0.3%
Miscellaneous	$2,089	0.2%
Interest on capital lease obligation	$1,663	0.2%
Website development	$950	0.1%
Total operating expenditures	**$872,963**	100.0%
Projects	**$282,178**	
Total expenditures	**$1,155,141**	

Source: BCMB, 2005.

Excess revenues over expenditures for the year were $115,000.

In sum,

- ***Program operations costs: $1,155,141***
- ***Per container equivalent costs: $0.001***

4.5.4 Collection System Agents

BCMB itself is not directly involved with the collection of beverage containers or collecting and remitting deposits or container recycling fees, nor is it directly involved with the processing and resale of containers for reuse or recycling. This is done by two collection system agents, the Alberta Beverage Container Recycling Corporation (ABCRC) and the Alberta Beer Container Corporation (ABCC). ABCRC handles all mandated beverage containers other than beer containers[4] which are handled by ABCC.

4.5.4.1 Alberta Beverage Container Recycling Corporation (ABCRC)

ABCRC is a not for profit industry driven stewardship corporation which is responsible for managing the system that collects and recycles empty registered beverage containers (other than domestic beer containers) from bottle depots on behalf of manufacturers who sell beverages in Alberta.[5] All manufacturers and distributors of registered beverages are required to participate in the common collection system if they wish to sell or distribute beverages in containers in Alberta. There is an exemption for distributors of beverages packaged in refillable containers, who are allowed to establish a separate collection system.

ABCRC is funded by unredeemed deposits, container recycling fees, and the sale of collected materials to commodity markets for recycling. Each container type category is required to generate enough money to support its recovery costs. Where there is insufficient money collected through unredeemed deposits and the sale of used containers to support the recovery costs of a container type, the manufacturer assesses and collects a container recycling fee (CRF) at the point of sale and remits these fees to ABCRC. Cross-container subsidization is minimized. For example, monies generated through unredeemed deposits on aluminum cans and the sale of aluminum cans to commodity markets cannot be used to support the recovery and recycling of HDPE plastic containers. The ABCRC system divides containers into 18 different types, based on material type and size.

As of February 2006 only three container types did not impose a container recycling fee. These are aluminum cans less than 1 litre, polycoat bag in a box containers over 1 litre, and bi-metal containers over 1 litre. (Note that these materials did contain a recycling fee in 2004, and as such, CRFs for these materials will appear in our cost benefit analysis). The remaining containers have CRFs ranging from 1 cent to 8 cents per container. Table 12 reviews the deposit refunds and CRFs collected by container type.

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[4] Technically, ABCC has responsibility for all beer containers but contracts ABCRC to handle imported beer containers.

[5] ABCRC is owned by Coca-cola, Pepsi, and Cott Beverages.

Table 12: Deposit and CRF Rates by Container Type (February 2006)

	Deposit Refund $	CRF $	Total Payable $
ALUMINUM			
0 - 1 Litre	0.0500	—	0.0500
AEROSOL			
0 - 1 Litre	0.0500	0.0800	0.1300
PLASTICS			
PET 0 - 1 Litre	0.0500	0.0200	0.0700
PET Over 1 Litre	0.2000	0.0300	0.2300
HDPE Plastic 0 - 1 Litre	0.0500	0.0400	0.0900
HDPE Plastic Over 1 Litre	0.2000	0.0200	0.2200
PVC 0 - 1 Litre	0.0500	0.0400	0.0900
PVC Over 1 Litre	0.2000	0.0200	0.2200
Polystyrene Cups 0 - 1 Litre	0.0500	0.0300	0.0800
Polypropylene 0 - 1 Litre	0.0500	0.0400	0.0900
Polypropylene Over 1 Litre	0.2000	0.0200	0.2200
GLASS			
0 - 500 ml	0.0500	0.0600	0.1100
501 - 1 Litre	0.0500	0.0600	0.1100
Over 1 Litre	0.2000	0.0800	0.2800
POLYCOAT			
Tetra Brik 0 - 1 Litre	0.0500	0.0200	0.0700
Tetra Brik Over 1 Litre	0.2000	0.0100	0.2100
Gable Top 0 - 1 Litre	0.0500	0.0200	0.0700
Gable Top Over 1 Litre	0.2000	0.0100	0.2100
Drink Pouches 0 - 1 Litre	0.0500	0.0200	0.0700
Bag-In-A-Box Over 1 Litre	0.2000	—	0.2000
BI-METAL			
0 - 1 Litre	0.0500	0.0500	0.1000
Over 1 Litre	0.2000	-	0.2000

Source: ABCRC (website), 2006.

In 2004 ABCRC handled over 840 million containers of the over 1.1 billion containers sold which fall under its jurisdiction to process. ABCRC therefore handled approximately 75% of the total available containers which they are authorized to process. ABCRC's responsibilities include the administration of deposits and CRFs, collection of containers from depots, remittance of deposits and handling commissions to depot operators, processing of containers, and sale of materials in their respective recycling markets. In addition, ABCRC is involved with container recycling education and promotion.

ABCRC generated over $58.9 million in revenues including $16.7 million in unredeemed deposits, $26.6 million in container recycling fees, and $14.4 million through the sales of processed containers. Expenditures totaled $48.8 million including $37.6 million in depot handling commissions, $363,000 in BCMB fees, and $10.8 million in operating expenditures. Excess revenues over expenditures for 2004 were just over $10 million. Table 13 highlights ABCRC revenues and expenditures.

Table 13: ABCRC Revenue and Expenditures

ABCRC Statement of Operations, Year Ended December 31, 2004			
	2004	Percent of total	per container rate*
Revenues			
Unredeemed deposits	$16,723,518	28.4%	$0.0199
Container recycling fees	$26,645,753	45.2%	$0.0317
Sale of processed containers	$14,367,707	24.4%	$0.0171
Other income	$1,251,281	2.1%	$0.0015
(loss) gain on foreign exchange	-$153,739		
	$58,834,520		$0.0700
Expenditures			
Handling commissions paid to depots	$37,626,194	77.1%	$0.0448
Beverage Container Management Board levy	$362,998	0.7%	$0.0004
ABCRC operating expenses	$10,834,671	22.2%	$0.0129
Warehouse	$4,650,931	9.5%	
Transportation	$3,008,388	6.2%	
Administration	$1,513,707	3.1%	
Marketing and technology	$1,258,899	2.6%	
Amortization	$402,746	0.8%	
	$48,823,863		$0.0581
Excess of revenues over expenditures	$10,010,657		

* per container handled by ABCRC (total containers processed = 840,725,200)

Source: ABCRC, 2005.

ABCRC had total expenditures of 5.8 cents per container processed, including a per container processed rate of 4.5 cents paid in handling commissions to depot operators.

A detailed look at expenditures for 2004 by material type reveals that the most cost effective material for ABCRC to handle is aluminum cans (see Table 14). The operating expenses, including processing, transportation, administration, advertising and system development costs, amount to 0.7 cents per aluminum container. This is significantly less than polycoat (1.6 cents per container), plastics (1.7 cents per container), glass (2 cents per container), and bi-metal (3.8 cents per container). In addition, ABCRC pays out the lowest handling fee to depots for aluminum at 2.8 cents per container and with strong aluminum markets generates the most in sales at 2.6 cents per container.

Table 14: ABCRC Expenditures by Material Type (2004)

	Total	per container*	Aluminum	per container	Plastics	per container	Glass	per container	Polycoat	per container	Bi-metal	per container
Volumes processed	840,725,200		385,454,600		224,338,600		138,694,900		89,138,000		3,099,100	
Beverage Container Management Board levy	$363,000	$0.000	$173,500	$0.000	$102,700	$0.0005	$45,000	$0.000	$40,300	$0.000	$1,400	$0.000
Handling commissions paid to depots	$37,626,200	$0.045	$10,755,800	$0.028	$13,869,400	$0.0618	$7,587,100	$0.055	$5,159,600	$0.058	$254,400	$0.082
ABCRC operating expenses	$10,834,700	$0.013	$2,716,300	$0.007	$3,802,200	$0.017	$2,776,500	$0.020	$1,423,200	$0.016	$116,400	$0.038
Processing	$4,650,900	$0.006	$796,700	$0.002	$1,635,300	$0.0073	$1,721,300	$0.012	$403,700	$0.005	$93,900	$0.030
Transportation	$3,008,400	$0.004	$934,600	$0.002	$1,124,600	$0.0050	$707,500	$0.005	$229,400	$0.003	$12,300	$0.004
Administration	$1,916,500	$0.002	$844,000	$0.002	$539,700	$0.0024	$323,200	$0.002	$200,900	$0.002	$8,700	$0.003
Advertising & system development	$1,258,900	$0.001	$141,000	$0.000	$502,600	$0.0022	$24,500	$0.000	$589,200	$0.007	$1,500	$0.000
Total expenditure	**$48,823,900**	**$0.058**	**$13,645,600**	**$0.035**	**$17,774,300**	**$0.0792**	**$10,408,600**	**$0.075**	**$6,623,100**	**$0.074**	**$372,200**	**$0.120**

* per container handled by ABCRC (total containers processed = 840,725,200)

Source: ABCRC, 2005.

Sales of aluminum containers generates two thirds of the total revenue earned through the sale of processed materials to recycling commodity markets while making up less than half of the volume processed by ABCRC. Table 10 reviews the revenue and expenditures by material type.

Table 15: ABCRC Revenue and Expenditures by Material Type

	Total	per container	Aluminum	per container	Plastics	per container	Glass	per container	Polycoat	per container	Bi-metal	per container
Volumes processed	840,725,200		385,454,600		224,338,600		138,694,900		89,138,000		3,099,100	
Revenues												
Regulated deposits	$68,264,100	$0.081	$23,897,700	$0.062	$26,421,000	$0.1178	$7,569,500	$0.055	$9,868,700	$0.111	$507,200	$0.164
Container recycling fees	$26,645,700	$0.032	$4,507,800	$0.012	$9,435,300	$0.0421	$8,646,400	$0.062	$3,898,300	$0.044	$157,900	$0.051
Deposits refunded to depots	-$51,540,600	-$0.061	-$19,207,100	-$0.050	-$20,226,700	-$0.0902	-$6,145,100	-$0.044	-$5,653,700	-$0.063	-$308,000	-$0.099
Subtotal	**$43,369,200**	**$0.052**	**$9,198,400**	**$0.024**	**$15,629,600**	**$0.0697**	**$10,070,800**	**$0.073**	**$8,113,300**	**$0.091**	**$357,100**	**$0.115**
Operating income (sale of materials + other income)	$15,465,200	$0.018	$10,047,100	$0.026	$3,822,800	$0.0170	$1,551,400	$0.011	$31,500	$0.000	$12,500	$0.004
Total revenues	**$58,834,400**	**$0.070**	**$19,245,500**	**$0.050**	**$19,452,400**	**$0.0867**	**$11,622,200**	**$0.084**	**$8,144,800**	**$0.091**	**$369,600**	**$0.119**
Expenditures												
Beverage Container Management Board levy	$363,000	$0.000	$173,500	$0.000	$102,700	$0.0005	$45,000	$0.000	$40,300	$0.000	$1,400	$0.000
Handling commissions paid to depots	$37,626,200	$0.045	$10,755,800	$0.028	$13,869,400	$0.0618	$7,587,100	$0.055	$5,159,600	$0.058	$254,400	$0.082
ABCRC operating expenses	$10,834,700	$0.013	$2,716,300	$0.007	$3,802,200	$0.017	$2,776,500	$0.020	$1,423,200	$0.016	$116,400	$0.038
Processing	$4,650,900	$0.006	$796,700	$0.002	$1,635,300	$0.0073	$1,721,300	$0.012	$403,700	$0.005	$93,900	$0.030
Transportation	$3,008,400	$0.004	$934,600	$0.002	$1,124,600	$0.0050	$707,500	$0.005	$229,400	$0.003	$12,300	$0.004
Administration	$1,916,500	$0.002	$844,000	$0.002	$539,700	$0.0024	$323,200	$0.002	$200,900	$0.002	$8,700	$0.003
Advertising & system development	$1,258,900	$0.001	$141,000	$0.000	$502,600	$0.0022	$24,500	$0.000	$589,200	$0.007	$1,500	$0.000
Total expenditures	**$48,823,900**	**$0.058**	**$13,645,600**	**$0.035**	**$17,774,300**	**$0.0792**	**$10,408,600**	**$0.075**	**$6,623,100**	**$0.074**	**$372,200**	**$0.120**
Excess of revenues over expenses	**$10,010,500**	**$0.012**	**$5,599,900**	**$0.015**	**$1,678,100**	**$0.007**	**$1,213,600**	**$0.009**	**$1,521,700**	**$0.017**	**-$2,600**	**-$0.001**

Source: ABCRC, 2005.

In sum,

- ***Program operations costs: $48,823,900***
- ***Per container equivalent costs: $0.058***
  (Per container recovered by ABCRC)

4.5.4.2 Alberta Beer Container Corporation (ABCC)

The Alberta Beer Container Corporation represents brandowners of beer sold in Alberta and is the agent responsible for the collection of beer containers. ABCC subcontracts the administration of the remittance system and the collection and processing of containers to Brewers' Distributor Limited. Brewers' Distributor Limited is a private joint venture corporation owned by Labatt Breweries of Canada, Molson Breweries, and Sleeman Breweries Ltd. In addition to collecting beer containers for recycling, they also redistribute bottles back to brand owners for reuse. A beer bottle can be reused 15-20 times during its lifespan.

As Brewers' Distributor Limited is a private corporation, operating revenue and expense information is not publicly available. We do know, however, that consumers paid $51.8 million in deposits on sales of domestic beer products and that $3.8 million in deposits were unredeemed (see Table 16). It is also estimated that Brewers' Distributor Limited generated over $8 million in the sale of aluminum containers. This assumes a per unit sale price of 2.6 cents.[6] We also know that ABCC paid handling fees to depots of approximately $13.6 million and paid fees to BCMB of $216,000.

Table 16: Beer Container Sales / Recovery Data

	Sold	Recovered	Deposits collected	Deposits redeemed	Unredeemed Deposits
Aluminum (beer)	347,855,112	316,553,556	$34,785,511	$31,655,356	$3,130,156
Glass (domestic beer)	170,589,924	164,232,636	$17,058,992	$16,423,264	$635,729
Total	518,445,036	480,786,192	$51,844,504	$48,078,619	$3,765,884

Source: BCMB, 2005.

There is no visible container recycling fee for domestic beer products. Any recycling costs are embedded directly into the price of the product. It is assumed, however, that the revenue generated through unredeemed deposits, the sale of used containers, and the avoided costs by reusing glass bottles offsets a large portion of the program costs.

In sum,

- ***Program operations costs: $ Not available***
- ***Per container equivalent costs: $ Not available***

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[6] 2.6 cents is the unit sale price of aluminum containers sold by ABCRC in 2004.

4.5.5 Depots

There are 216 universal depots in Alberta and 78 Class D beer depots. Class D beer depots collect beer containers only (BCMB, 2005). Universal depots are required to accept all registered beverage containers. Depot operators are responsible for taking empty beverage containers and remitting a deposit for each container returned. The deposit remitted upon the return of containers is the same as that paid by consumers at the point of sale. In addition to refunding deposits, depots are required to sort and store containers until pick up from ABCRC or ABCC.

Collection system agents reimburse depot operators for the deposits paid out. In addition collection system agents pay depot operators a handling commission to compensate them for recovering and temporarily storing containers.

Handling commissions range from 2.8 cents to 8 cents per container depending on the product. ABCRC paid out $37.6 million in handling commissions to depots in 2004. While the amount paid out by ABCC is not publicly available, based on a handling fee of 2.83 cents per domestic beer container and 480.7 million containers recovered, it is estimated that ABCC paid depots $13.6 million in handling commissions.

Revenue and expenditure data is available for the 216 universal depots. Data reported here is based on estimates derived by Stantec (2005) in a report produced which collected financial data on depots to help the BCMB set handling commissions.

Revenue for universal depots was $41.1 million or 4 cents per container. Total expenditures were $31.0 million or 3 cents per container. Two-thirds of that amount went towards labour costs. Table 17 reviews universal depots aggregate revenue and expenditures.

Table 17: Universal Depots Aggregate Revenue and Expenditures (2004 fiscal year)

2004 Fiscal Year	$	Per depot average $	$ per container*
Revenue	$120,302,112	$556,954	0.1173
Less purchases	$79,503,570	$368,072	0.0775
Gross Margin	$40,798,541	$188,882	0.0398
Misc Revenue	$351,001	$1,625	0.0003
Total Margin	**$41,149,542**	**$190,507**	**0.0401**
Expenses			
Direct Labour	$16,383,917	$75,851	0.0160
Overhead Labour	$3,941,171	$18,246	0.0038
Labour subtotal	$20,325,087	$94,098	0.0198
Building	$4,964,332	$22,983	0.0048
Equipment	$543,174	$2,515	0.0005
Overhead (Ex-collections)	$5,127,421	$23,738	0.0050
Total Operating Expenses	**$30,960,014**	**$143,333**	**0.0302**
Earnings before taxes	$10,156,628	$47,021	0.0099
Taxes (theoretical)	$2,693,538	$12,470	0.0026
Net Income	**$7,463,090**	**$34,551**	**0.0073**

*per container returned to universal depots

Source: Stantec, 2005.

After tax net income for the 216 depots was $7.4 million dollars or $34,600 per depot. This equates to 0.7 cents per container (returned to universal depots).

In sum:

- ***Depot- operations costs: $30,960,014 (universal depots only)***
- ***Per container equivalent costs: $0.030***

4.5.6 Industry Costs (Manufacturers and Retailers)

While the industry bears very little direct costs for the beverage container stewardship program they are actively involved in the program. In addition to being required to partake in the program, both collection system agents, the ABCRC and ABCC are industry led corporations. Furthermore industry representatives sit on the Beverage Container Management Board. The beverage container industry was also involved with the set up and design of the program. While there are costs associated with this, we do not attempt to monetize them in our cost-benefit analysis because of a lack of data on the value of these contributions.

Manufacturers and retailers facilitate the collection of deposits and CRFs. Retailers remit deposits and CRFs to manufacturers on wholesale product purchases, and in turn collect them from consumers at the point of sale. Manufacturers in turn distribute this money to the collection system agents. While the source of this money ultimately comes from the consumer, there is an administration costs borne by retailers and manufacturers. BCMB suggests that these costs are negligible and to their knowledge retailers or manufacturers have not been required to increase staff time to cover the extra administrative responsibilities (Saari, 2005).

The beverage container industry directly supports the program through a container levy paid to BCMB and a product registration fee required to be paid on all new products being sold in the province. In 2004 manufacturers/brandowners paid BCMB just under $600,000 in container levies and just over $50,000 in product registration fees.

In sum:

- ***Industry costs: $650,000***
- ***Per container equivalent costs: $0.000***

4.5.7 Government Support Costs

The Beverage Container Management Board is a delegated administrative organization (DAO), which operates at an arms length from the government, providing transparency and accountability. The government does, however, provide program oversight, and an employee from Alberta Environment has a seat on the board. Alberta Environment also provided support to help develop and introduce the program.

Based on estimates provided by Alberta Environment (2005), they provided $70,000 in staffing time to assist with program development and launch costs in 1997. If we distribute this amount over the length of program operation (8 years – 1997-2004), it equals $8,750 per year. Ongoing support is estimated at 2 days per month in total staffing time. This includes the combined time allocated by program staff, managers, and the assistant deputy minister. Assuming an average annual salary of $80,000 and 261 workdays per year this equals ongoing government support costs of $7,356.32.

- ***Government support costs (2004): $16,106***
- ***Per container equivalent costs: $0.000***

4.5.8 Consumer / Household

Consumers pay a deposit on the purchase of all registered beverage containers ranging from 5 cents on containers less than 1 litre in size to 20 cents on containers 1 litre in size or larger. A deposit of 10 cents is charged on the purchase of all beer bottles and cans. Deposits are paid at the point of sale. The full deposit is refunded when empty beverage containers are returned to depots. The deposit model is designed to provide an incentive to encourage consumers to return empty beverage containers to depots for recycling or reuse. Deposits from consumers who do not return containers are left within the system to support program operations.

In 2004, consumers paid over $120 million in deposits. Almost $100 million of this amount was refunded back on containers returned to depots. In addition to paying a deposit, consumers pay a container recycling fee on most container types to cover the costs of recovery. See Table 12 above for container recycling fees by container type. Consumers paid $26.6 million in container recycling fees. Table 18 highlights the costs borne by the consumer.

Table 18: Fees Paid by Consumers to Support Program

Deposits	**ABCRC**	**ABCC**	**Total**
Collected	$68,264,100	$51,844,504	$120,108,604
Refunded	$51,540,600	$48,078,619	$99,619,219
Unredeemed	$16,723,500	$3,765,885	$20,489,385
Container recycling fees:	$26,645,752		
Monies paid by consumers and not recovered:			$47,135,137

Source: BCMB, 2005.

- ***Direct costs incurred by consumer (unredeemed deposits and container recovery fees): $47,135,137***
- ***Per container equivalent costs: $0.0285***

In addition to the direct costs paid by consumers, they support the program in other ways. Two notable areas include transporting containers to depots for recycling and the time costs incurred for collecting, sorting, and storing containers.

4.5.8.1 Consumer / Household Transportation

From a household perspective, a depot-based program is transportation intensive, as households are responsible for transporting empty containers to depots. Without trip data, however, it is difficult to ascertain the incremental transportation burden on households. It is important to consider such factors as how often households return empty containers, and whether the trip is part of a multi trip outing.

It is estimated that the average householder lives within three kilometres of a depot and that the average household typically returns empty containers 6.2 times per year (Linton, 2006).[7] The total number of households in Alberta in 2004 was 1,149,840 (Statistics Canada, 2005b). BCMB estimates that the program has a 96% participation rate (London, 2006). It is important to note, however, that not all people who participate in the program return all eligible containers. If we multiply the number of households participating by the distance traveled and number of trips per year, we can estimate that 41,063,086 km were traveled to return beverage containers in 2004. Using the average fuel efficiency of the Alberta vehicle fleet for light vehicle passenger transportation of 12 litres/100 km (Transport Canada, 2004) indicates that 4,927,570 litres of gasoline were consumed by households on trips to return beverage containers. At a gasoline price of 72.2 cents per litre (Statistics Canada, 2006d), it costs households $3.6 million dollars in fuel costs to make these trips. Transportation costs extend beyond gasoline. If we use a conservative per-kilometer cost allowance of $0.36 per kilometer, which takes into account the wear and tear on a vehicle, it costs households $14.8 million to return beverage containers to depots.

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[7] The distance traveled per trip varies for urban and rural areas. 80% of the population lives within 3 kilometers of a depot. In rural areas it can be significantly more but according to ABCRC the average distance to a depot province wide is 3-4 km (London, 2006).

The nature of these trips, however, is not known. Are trips specifically dedicated to returning empty beverage containers or are they a stop as part of a multipurpose trip? Given the challenge in deciphering the exact nature of the trips we cautiously include transportation costs to households in our full cost-benefit bottom line. As a low estimate we assume that returning beverage containers is typically done as part of a multi trip outing and attribute only 25% of the total costs to returning containers. Our mid range estimate attributes 50% of the total transportation costs to returning containers. (The GHG emission costs of transportation are discussed in the GHG section and the time involved with transportation is addressed below). We estimate that household transportation costs range from $3.7 million to $14.8 million.

- ***Household transportation costs: $3,696,000 – $14,783,000***
- ***Per container equivalent costs: $0.003 – $0.011***

4.5.8.2 Time

From a household perspective, the largest non-direct cost is time. This includes the time to sort, clean, and store empty containers and the time required to transport containers to depots. The GPI Atlantic Solid Waste Accounts (2004) estimated that the cost of recycling items including cleaning, sorting and storing as opposed to putting these items in the garbage required an additional minute per day. The GPI Atlantic estimate includes all items being recycled as part of the Nova Scotia Solid Waste Resource System. It is estimated that beverage container recyclables makes up approximately 25% of the total material being recycled suggesting that households contribute on average 15 seconds per day to recycle beverage containers (Kenney, 2006)

In addition to cleaning and sorting, there is an additional time cost incurred returning containers to depots. It is estimated that the average driving time for a household to reach a depot is four minutes based on 3 km of travel and a speed of 50 km/hour (Saari, 2005). Total round trip driving time is eight minutes. As noted above in the household transportation costs, it is difficult to determine the additional time burden this imposes on households without trip data. Taking a conservative approach we have discounted the trip time by 75% to account for multi-trip outings.

In addition to the driving time, there is also the time required to physically drop off the material and redeem the deposits. There are no studies measuring this factor, however, speculative estimates from those close to the industry suggest an estimate of 5 minutes per visit. The total time required to return empty beverage containers to depots is 7 minutes per visit. Given that it is estimated that the average household returns containers 6.2 times per year, the total time per household = 7 (minutes per visit) X 6.2 (# visits per year) + 91 (time sorting etc beverage containers per year) = 135 minutes or 2.2 hours per year per household.

The total number of households participating in the program (based on a 96% participation rate) is 1,103,846 (Linton, 2006; Statistics Canada, 2005b). If we multiply this number by the total time per household we get a total time commitment to return beverage containers in 2004 of 2.5 million hours. To determine the associated value of this time to households we multiplied the number of hours by the average hourly wage in Alberta which is $19.72 per hour (Statistics Canada, 2005a). Household time costs equal 2.5 million hours X $19.72/hour (average hourly wage) for a total time value of $48.8 million. An alternative estimate based on the cost to hire someone to do the associated household work using the average hourly wage of an employee in the service industry of $14.36 (November 2005, Statistics Canada, 2006a) gives a total time value of $35.5 million.

- ***Household time costs: $35,500,000 – $48,760,000***
- ***Per container equivalent costs: $0.027 – 0.037***

4.5.9 Disruption in Marketplace

According to an Environment Canada review of extended producer responsibility and stewardship programs in Canada, the recycling of beverage containers in Alberta operates on a level playing field. This is attributed to the fact that the program is mandatory and consistent throughout the province (2002).

The recycling of beverage containers, however, operates in a very controlled market. BCMB regulates the number of depots restricting entry into the marketplace. There is also a mandated relationship between depots and collection system agents where depots must sell containers to ABCRC and ABCC respectively while ABCRC and ABCC are obligated to collect all beverage containers (under their jurisdictions) from depots compensating them at a given rate per container set by BCMB. In addition, the refunds paid by depots to those returning containers is set by regulation.

The regulated fee arrangement imposed on depots in terms of the amount they are compensated by collection system agents and the amount that must be paid out has created disparity in the financial viability of depots. A study by Stantec (2005) on handling commission fees indicated that there is a discrepancy in profitability between small depots and large depots.

As a result of the beverage container stewardship program there has been a significant increase in the quantity and quality of recovered recyclable materials. The supply of recyclable materials has stimulated end markets for these products in Western Canada, possibly impacting industries that would have provided alternate materials that the recycled materials have replaced (Environment Canada, 2002).

While there are notable disruptions in the marketplace, especially in terms of barriers to entry and controlled prices, the regulations mandating the program are consistent throughout the province. Given the challenges of estimating a dollar value to these impacts we have not attributed a value to the disruption in market place costs.

- ***Disruption in market place costs: not estimated***
- ***Per container equivalent costs: not estimated***

4.5.10 GHG Costs

While there are GHG emissions associated with the collection and processing of used beverage containers, recycling them on the whole generates an overall greenhouse gas benefit. This analysis does not break out GHG costs and benefits by component but uses the summary level findings from the ICF Consulting report prepared for Environment Canada and NRCan. The overall greenhouse gas impact of beverage container recycling is considered in the GHG emissions benefit section below.

It is important, however, to highlight facets of the program where GHG emission costs occur. One notable area is transportation. The beverage container recycling program may be associated with increases in the amount of transportation required to recover containers as opposed to landfilling them or disposing of them in a blue box type program. There is the transportation of containers from households to depots as discussed above. In addition, there is a transportation cost borne by ABCRC and ABCC to collect materials from depots for transportation to processing facilities. There is also the transportation required to ship materials to commodity markets.

As noted above, it is very difficult to decipher household transportation data associated with returning containers to depots. The transportation costs involved with collection and delivery of containers from depots to processing facilities is more readily available. In 2004, ABCRC spent just over $3 million on transportation costs to pick up beverage containers. At an average diesel gasoline price cost of 73.8 cents/litre in Alberta (Statistics Canada, 2006c, annual average for 2004), this equates to over 4 million litres of diesel fuel consumed to transport containers from depots to processing facilities. While financial information is not available for ABCC, using the differential in bottles recovered as a proxy for fuel consumption would suggest that ABCC consumed 2.5 million litres of fuel transporting used beverage containers to centralized processing points.

Using the more reliable ABCRC fuel data as an example, **the consumption of 4 million litres of diesel fuel equates to approximately 10,975 tonnes of CO_2 equivalent**. This is based on a conversion rate of 2.69 kg of CO_2/litre of diesel fuel. If we factor in GHG emissions emitted by households on trips to return beverage containers (without considering trip profile data), GHG emissions associated with transportation could be as high as 23,885 tonnes of CO_2 equivalent.[8] The costs of these emissions are factored into the overall GHG cost/benefit estimate below.

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[8] CO_2 equivalent estimates are based on household transportation using regular grade gasoline.

4.5.11 Reduction in Greenhouse Gas Emissions Benefit

When a container is reused or recycled, there is a significant energy savings and associated greenhouse gas (GHG) emissions savings. The reduction in greenhouse gas emission benefits estimated for this report are based on the report, *Determination of the Impact of Waste Management Activities on Greenhouse Gas Emissions 2005 update* completed by ICF Consulting for Environment Canada and Natural Resources Canada.[9] The net recycling emission factor for reusing glass is from the Brewer's Retail 2004-2005 Responsible Stewardship Annual Report audited by Ernst and Young.

Based on these conversion factors, it is estimated that the beverage container stewardship program has led to a total net emissions reduction of 110,900 metric tonnes of carbon equivalent. Table 19 shows the reduction in greenhouse gas emissions by beverage container type achieved through recycling and reuse as opposed to landfilling these items.

Table 19: Greenhouse Gas Savings

Material	Net Recycling Emissions vs Landfill (MTCE/ tonne)*	Tonnes Diverted (2004)	Net Emissions (MTCE)
Glass (recycled)	-0.12	35,021	-4,203
Glass (reused)	-0.38	36,199	-13,756
PET	-3.64	6,854	-24,947
HDPE	-2.29	228	-523
Other plastic	-1.82	44	-81
Aluminum	-6.51	9,813	-63,883
Steel	-1.16	253	-293
Polycoat	-1.82	1,755	-3,194
Total System			**-110,878**

Sources: ICF Consulting, 2005 – note other plastic used as proxy for polycoat; Brewers Retail, 2005.

The net emission reduction by recycling aluminum was the largest totaling almost 64,000 metric tonnes of eCO_2.

This report estimates a high end per-tonne eCO_2 value based on the social cost of carbon used in Britain's Stern Review on the Economics of Climate Change (2006). The review calculates the damage done over time by a tonne of CO_2 emitted this year, if the world continues on a business-as-usual (BAU) scenario. The social cost of carbon under the BAU is estimated at US\$85/tCO_2 (2000\$) now, and rising over time. We converted the current value as C\$142/tCO_2 (2005\$). It is important to note that the Stern Review is based on the latest science, which predicts greater increases in global average temperature (at least 5 degrees Celsius, compared with previous estimates of 2-3 degrees Celsius).

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[9] Although this model was developed for Canada and does not specifically represent the recycling system utilized in Alberta, it is assumed that the variances are not significant.

As a low end per-tonne eCO_2 value we use the European carbon trading market value which we estimate at C$7.48/tC (4.37 Euros/tC) based on April 4, 2006 trading values. This translates to C$27/$tCO_2$. We recognize that the true value may very well fall in between these limits and therefore as a middle value estimate selected the mid point between the Stern Review cost of carbon value and the European carbon trading market value. The proposed middle estimate is $85/tonne eCO_2.

Table 20 highlights greenhouse gas reduction benefit values based on the established/tonne eCO_2 range estimates referenced in this report.

Table 20: Greenhouse Gas Reduction Benefits ($ Range Low, Medium, High)

Estimated GHG $ reduction benefits	Low estimate ($27/tonne CO_2)	Medium estimate ($85/tonne CO_2)	High estimate ($142/tonne CO_2)
GHGs avoided	110,878	110,878	110,878
Total benefit	$2,740,000	$8,625,000	$14,408,000
Benefit per container	$0.002	$0.007	$0.011

Table 20 highlights possible greenhouse gas reduction benefit values

- ***Greenhouse gas reduction benefit: $2,740,000 – $14,408,000***
- ***Greenhouse gas reduction benefit per container: $0.002 – $0.011***

4.5.12 Extended Landfill Life

4.5.12.1 Disposal Costs

In assessing a reasonable value for landfill cost, it could be argued that landfills operated by the private sector are profit driven and may better reflect actual costs. Essentially, the operations of a private-sector company are bound to be profitable by the expectations of its shareholders. Therefore, private landfill operators must account for all direct and potential costs associated with their operations. It is reasonable, then, to suggest that the rates charged by private landfills are a good proxy of the full costs, excepting those costs borne by society as a whole.

Discussions with Waste Management Inc. have concluded that the average gate rate at a private landfill is approximately $42/tonne (Hantiuk, 2006).

An average of landfill tipping fees across Alberta as reported to Alberta Environment in 2005 was $37/tonne. This suggests a similar range to the private sector costs above.

It is often asserted by waste reduction advocates that the costs of landfill disposal are generally underestimated, and that the full costs of operating a landfill are not reflected in the tipping fee. By not accounting for the full costs of landfill disposal, alternative measure such as recycling and composting are placed at an economic disadvantage.

In many cases, only direct capital and operating costs are taken into account when determining landfill costs. It is recognized that indirect costs, including health risks, property value depreciation, environmental risks, lost opportunity and quality of life must also be taken into account (AOW, 1995).

The $42/tonne disposal estimate for private landfills does not include costs borne by society in general, potentially neglected future siting costs, unanticipated closure and post closure costs, nor the nuisance costs and potential loss of property value costs borne by neighbouring residents and potential future environmental pollution risks.

A University of Toronto Department of Economics report on municipal user fees suggested that the marginal social costs for landfill disposal were in excess of $50/tonne in the Toronto region, while as low as $30/tonne in other regions of Canada (Dewees, 2002). Adding these social costs would suggest a full valuation of landfill at $72-$92/tonne.

Compacted garbage has a density of 1,200-1,500 pounds/yd^3 (CSR, 2003). Based on this, one tonne of garbage takes up 1.5-1.8 yd^3. Therefore, a landfill cost of $72/tonne would translate into approximately $40-$48/yd^3, whereas $92/tonne would equate to $51-$61/yd^3.

Therefore we estimate a landfill disposal cost range of:

- Low: $40/yd^3
- Medium: $50/yd^3
- High: $61/yd^3

CM Consulting (2002) referenced the following extended landfill conversion factors by beverage container type.

Table 21: Extended Landfill Conversion Factor by Beverage Container Type

	Glass	Aluminum	PET	HDPE
Equivalent Landfill Space, yd^3/tonne	2.72	7.53	8.98	14.06

Source: CM Consulting, 2002.

Based on the equivalent landfill space values presented in Table 21, the following table outlines landfill space savings and extended landfill dollar savings.

Table 22: Extended Landfill Savings

	Savings Cubic yards	Low estimate ($40.00/yd^3)	Medium estimate ($50/yd^3)	High estimate ($61/yd^3)
Glass	193,718	$7,748,736	$9,685,920	$11,816,822
PET	61,549	$2,461,957	$3,077,446	$3,754,484
HDPE	3,206	$128,227	$160,284	$195,546
Other plastic	619	$24,746	$30,932	$37,737
Aluminum	73,892	$2,955,676	$3,694,595	$4,507,405
Steel	1,905	$76,204	$95,255	$116,210
Polycoat	13,215	$528,606	$660,758	$806,124
Total System	**348,104**	**$13,924,151**	**$17,405,189**	**$21,234,330**

Note: HDPE used as proxy for other plastics, aluminum used as proxy for steel and polycoat.

Sources: CM Consulting, 2002; ABCRC, 2005; BCMB, 2005.

- ***Extended landfill life benefit 2004: $13,924,000 – $21,234,000***
- ***Extended landfill life benefit per container: $0.011 – $0.016***

4.5.12.2 Avoided Siting Costs

The above extended landfill life values have factored in avoided siting costs. To demonstrate the significance of siting costs we have separated this component out. The following list overviews siting costs examples referenced in the GPI Atlantic cost-benefit analysis of the Nova Scotia solid waste system (2004).

- Regional District of Kootenay, BC – $3-$4 million
- Ontario Municipalities (research and siting costs) – $2.16/tonne (2000$);
- Halton, Ontario – $2/tonne (1996$);
- Landfills serving large municipalities – $1.43-$1.58/tonne (1996$)
- Otter Lake facility serving Halifax Regional Municipality – $0.55/tonne (2000$)

The values referenced in the GPI Atlantic report (2004) give an avoided siting cost range of $0.55-$2.16/tonne (2000$). Updating these values to $2004 using the consumer price index gives a range of $0.60-$2.37/tonne.[10]

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[10] The consumer price index between 2000 and 2004 increased by 9.8% (Statistics Canada, 2006).

Table 23: Avoided Siting Costs

	Savings (Tonnes)	Low estimate ($0.60/tonne)	High estimate ($2.37/tonne)
Glass	71,220	$42,732	$168,791
PET	6,854	$4,112	$16,244
HDPE	228	$137	$540
Other Plastic	44	$26	$104
Aluminum	9,813	$5,888	$23,257
Steel	253	$152	$600
Polycoat	1,755	$1,053	$4,159
Total System	**90,167**	**$54,100**	**$213,696**

Sources: GPI Atlantic, 2004; ABCRC, 2005; BCMB, 2005.

As indicated in Table 23, the savings by delaying the potential siting costs of a new landfill range from $54,000 to $214,000. These estimates are included as part of the extended landfill life savings but are noted here to demonstrate the significant costs involved in simply locating new landfill sites.

4.5.13 Energy Savings

Recycling or reusing beverage containers in place of using virgin materials leads to substantial energy savings. This includes savings from the avoided extraction, processing, and transportation costs by replacing the use of virgin feedstock. In the case of reusing glass the manufacturing functions of producing new glass are also eliminated. Table 24 highlights the avoided barrels of oil utilized/tonne of recycled material.

Table 24: Select Parameters Applicable to Beverage Container Recycling

Parameter, per tonne	Glass	Aluminum	PET	HDPE
Avoided Barrels of Oil Utilized per tonne Recycled	0.18	24.76	4.08	2.36

Source: CM Consulting, 2002

As domestic beer bottles are reused 15 to 20 times before being recycled, we separated out the tonnage of domestic beer bottles recovered into those that are reused and those that are recycled. We estimated a conversion factor for bottles being reused based on a Brewers of Canada (2004) report audited by Ernst and Young which indicates that refillable bottles consume 56% less energy than one-way bottles.

Based on the conversion factors presented in Table 24, over 337,000 barrels of oil in energy savings were achieved as a result of recycling beverage containers in place of using virgin materials. Table 25 highlights the energy savings by beverage container material and the equivalent dollar savings. The dollar savings are based on a barrel of oil price of $68.97/barrel which was the average barrel of oil cost in 2004 (Bloomberg, 2005; Bank of Canada, 2006).

Table 25: Energy Savings by Material (CM Consulting data)

	Tonnes Recycled	Tonnes recovered	Energy savings (barrels of oil)	Dollar savings ($68.97 per barrel)
Glass (ABCRC)	32,608		5,869	$404,815
Glass (ABCC)	2,413	36,199	10,599	$731,010
PET	6,854		27,964	$1,928,699
HDPE	228		538	$37,111
Other Plastic	44		104	$7,162
Aluminum	9,813		242,970	$16,757,633
Steel	253		6,264	$432,047
Polycoat	1,755		43,454	$2,997,009
Total system	**53,968**		**337,763**	**$23,295,486**

Sources: CM Consulting,2002; Brewers Retail, 2005.

The dollar savings in avoided energy costs as a result of recycling totaled over $23 million. Almost 72% of these savings are a result of recycling aluminum beverage containers.

Energy savings as a result of recycling can also be calculated using the WAste Reduction Model (WARM) emission factors published by the US EPA (2005). Table 26 reviews the BTU conversion factor per ton recycled.

Table 26: WARM Emission Conversion Factors

Material	**Energy Savings (million BTUs / ton recycled)**
Glass	2.66
PET	53.36
HDPE	51.43
Other plastic	52.95
Aluminum	206.95
Steel	20.50
Polycoat	17.27

Source: USEPA WARM Emission Factors, 2005.

Based on the WARM emission conversion factors presented in Table 26, the equivalent of over 450,000 barrels of oil were saved as a result of beverage container recycling and reuse in Alberta. This equates to a total savings of over $31 million in 2004. For the entire system, the EPA WARM emission factors are approximately 25% higher than the CM Consulting report. Table 27 highlights the energy savings by beverage container material and the equivalent dollar savings. BTUs are converted to barrels of oil using the conversion that 1 barrel of crude oil is equivalent to approximately 2.6 million BTUs (Oregon Dept of Energy, 2005). As with the CM Consulting conversion factors used above, we accounted for the percentage of glass bottles being reused using the

Brewers of Canada (2004) estimate that refillable bottles consume 56% less energy than one-way bottles. The dollar savings are based on a barrel of oil price of $68.97/barrel which was the average barrel of oil cost in 2004 (Bloomberg, 2005; Bank of Canada, 2006).

Table 27: Energy Savings by Material (WARM Data)

	Tons recycled	Tons reused	Energy savings (million BTUs/ton recycled)	Energy savings (barrels of oil)	Dollar savings ($68.97/barrel)
Glass	64,610		171,863	29,631	$2,043,683
Glass (ABCRC)	29,582		78,687	13,567	$935,698
Glass (ABCC)	2,189	32,839	142,093	24,499	$1,689,677
PET	6,218		331,792	57,206	$3,945,470
HDPE	207		10,646	1,836	$126,596
Other Plastic	40		2,118	365	$25,186
Aluminum	8,902		1,842,269	317,633	$21,907,118
Steel	230		4,715	813	$56,068
Polycoat	1,592		27,494	4,740	$326,940
Total system	**113,570**		**2,611,677**	**450,289**	**$31,056,437**

Sources: ABCRC, 2005; BCMB, 2005; US EPA, 2005.

Similar to the CM results, recycling aluminum beverage containers contributes most to the energy savings benefit achieved by recycling as opposed to processing new containers. The EPA WARM factors indicate that recycling aluminum accounts for 71% of the total energy savings.

- ***Energy savings benefit 2004: $23,295,000 - $31,056,000***
- **Energy savings benefit per container: $0.018 - $0.024**

4.5.14 Litter

In contrast to the enormous liability of tire fires and the potentially devastating impacts caused by used oil entering the natural environment especially water systems, empty beverage containers pose relatively little environmental and human health liability. Beverage container litter does, however, have a damaging impact. It poses a health hazard from injuries caused by broken glass and has a negative aesthetic impact on our communities and recreation areas.

Having a refund incentive on all beverage containers encourages the recovery of containers. There is a strong correlation between refund-based beverage container programs and a dramatic reduction in beverage container litter. A literature review conducted by the Container Recycling Institute (2005) found that states with bottle bills had a 69-84% decrease in beverage container litter and an overall reduction in litter of between 30 and 60%. See Table 28 below.

Table 28: Litter Reduction Rates

State	Beverage Container Litter Reduction	Total Litter Reduction
New York	70 - 80%	30%
Oregon	83%	47%
Vermont	76%	35%
Maine	69 - 77%	34 - 64%
Michigan	84%	41%
Iowa	76%	39%
Massachusetts	N/A	30 - 35%

Source: Container Recycling Institute, 2005.

Table 29 highlights litter reduction estimates for every tonne of beverage container material type recovered. For example, it is estimated that every tonne of aluminum recycled prevents over 600 aluminum cans from being littered in the environment.

Table 29: Avoided Litter Conversion Factor by Beverage Container Type

Parameter, per tonne	Glass	Aluminum	PET	HDPE
Avoided Litter per tonne (No. Containers)	41.5	600.7	242.14	242.01

Source: CM Consulting, 2002

As a result of the beverage container stewardship program in Alberta, it is estimated that 11.8 million containers are recovered which would have ended up in the environment as litter. This includes almost three million glass bottles.

Table 30: Avoided Litter

	Savings (tonnes)	Avoided Litter (containers)
Glass	71,220	2,955,630
PET	6,854	1,659,628
HDPE	228	55,178
Other plastic	44	10,648
Aluminum	9,813	5,894,669
Steel	253	151,977
Polycoat	1,755	1,054,229
Total System	**90,167**	**11,781,959**

Sources: CM Consulting, 2002; ABCRC, 2005; BCMB, 2005.

It is difficult to assign a dollar benefit value to avoided litter. A study conducted for the State of Massachusetts estimated that the direct health savings in reduced emergency visits caused by injury from broken glass is $7.72/tonne of material recovered (Morris, 1998). For avoided glass litter in Alberta, this translates to almost $550,000 annually. If you include the damage caused to farm equipment, vehicle and bicycle tire punctures, the cost savings in reduced glass bottle litter alone would be significant (Morris, 1998).

Highway litter clean-up in Alberta costs $92/km, based on Alberta Infrastructure and Transportation estimates (Griffiths, 2006). How much this would increase due to additional beverage containers in absence of the stewardship program is hard to estimate. However, applying the previous overall litter reduction rates of 30-60% reported in bottle bill states, would suggest that, without a beverage container recycling program, highway litter cleanup could increase to $131-$230/km, or an increase of $41-$138/km. This could represent a cost savings, as a direct result of the beverage container recycling program, in the order of $238,000-$800,000 for the ~5,800 km of highway cleaned per year in Alberta.

More generally, reduced litter improves aesthetics especially in recreational areas and along highways. There is also strong anecdotal evidence that regions with less litter present a more welcoming environment to visitors potentially increasing tourist dollars. In addition, clean streets help foster a sense of community pride.

While we do not attach a dollar value to these aesthetic benefits of reduced litter, it is well recognized that reducing litter is a leading factor in motivating beverage container deposit programs (CRI, 2006). It was also a primary driver behind the introduction of the beverage container recycling program in Alberta.

- ***Reduced litter savings benefit 2004: $788,000 – $1,350,000***
- ***Reduced litter savings benefit per container: $0.0006 – $0.001***

4.5.15 Air and Water Consumption and Pollution

It is generally understood that recycling reduces emissions of criteria air pollutants, airborne toxics, and waterborne pollutants and toxics as opposed to landfilling or incineration (CM Consulting, 2002). Table 31 compares air and water pollutant emissions generated by landfilling, incineration, and recycling.

Table 31: Air and Water Pollutant Emissions

**All units in lbs/ton	Total (Per Ton of MSW Landfilled)	Total (Per Ton of MSW Incinerated / Waste-to-Energy)	Total (Per Ton of Material Recycled)
Atmospheric Emissions			
Aldehydes	0.0189	0.0141	(0.5134)
Ammonia	0.0001	(0.0005)	(0.0076)
Carbon Dioxide	317.1000	979.1000	(2494.3000)
Carbon Monoxide	0.9760	0.8006	(25.1866)
Chlorine			(0.0452)
Hydrogen Fluoride			(0.1766)
Lead			(0.0062)
Hydrogen Chloride		0.2500	
Metals		0.0002	
Hydrocarbons	0.3872	(0.3761)	(6.7446)
Methane	123.0002	(0.0043)	(0.0100)
Nitrogen Oxides	1.0214	(0.2239)	(9.4387)
Other Organics	0.5961	0.4614	(0.2730)
Particulates	0.2269	(1.9756)	(11.3020)
Sulfur Oxides	0.1440	(5.6834)	(10.8742)
Waterborne Wastes			
Acid		(0.5280)	(0.4416)
Ammonia			(0.0944)
BOD	0.0003	(0.0002)	(0.5376)
COD	0.0016	(0.0004)	(1.4858)
Cyanide			(0.0038)
Dissolved Solids	0.3264	0.0094	(5.3447)
Fluorides			(0.1040)
Iron	0.0003	(0.3952)	(0.0778)
Metal Ion	0.0006	(0.1315)	(0.2054)
Oil	0.0039	0.0023	(0.0436)
Phenol			(0.0024)
Sulfuric Acid	0.0010	(0.0040)	(0.0014)
Suspended Solids	0.0003	(0.0007)	(2.4992)

Source: Northeast Recycling Council, 2005.

As these estimates are not broken down by material type, it is difficult to quantify the reductions in air and water emissions as a result of beverage container recycling. However, it can be concluded that reductions in air and water emissions are significant, and that alternate systems with lower recovery rates would result in increased emissions.

Some estimates of water conserved through material recycling are show in Table 32 below:

Table 32: Water Savings Through Material Recycling

	Recycled (tonnes)	Water conserved / tonne recycled (tonnes)*	Water conserved (tonnes)
Glass	32,608	2	65,216
PET	6,854	(12)	-82,933.4
HDPE	228	(10)	-2371.2
Other plastic	44	(10)	-457.6
Aluminum	9,813	233	2,288,391.6
Steel	253	1	278.3
Polycoat	1,755	?	
Total System	90,167		2,268,124

***Source: New South Wales Dept of Environment and Conservation**

As shown, based on the indicated coefficients of water conservation, Alberta's beverage system potentially represents over 2 million tonnes (m^3), or more than 2 billion litres, of water savings through recycling.

Commercial water rates in the City of Edmonton vary from \$0.49-\$0.84 per m^3, while Calgary varies from \$0.45-\$0.69 per m^3. Applying these values would provide a cost savings of \$1.021 million to \$1.905 million.

- ***Reduced air and water pollution savings benefit 2004: Not estimated***
- ***Water conservation savings benefit: \$1,021,000 - \$1,905,000***
- ***Reduced air and water pollution savings benefit per container: Not estimated***
- ***Water conservation savings benefit per container: \$0.001***

4.5.16 Direct Employment

While there are no official figures accounting for the number of jobs supported by the beverage container stewardship program, employment numbers from BCMB, ABCRC, ABCC, and the depots suggest an estimate of 2,100 direct jobs. Table 33 reviews the number of full time equivalent positions by employer associated with the beverage container stewardship program. As ABCC does not publish employment data, a crude figure was estimated based on bottle recovery differentials between ABCC and ABCRC.

Table 33: Employment Estimates Attributed to Stewardship Program

Employer	Full Time Equivalent Positions
BCMB	5
ABCRC	60
ABCC	35
Bottle depots	2,000
Total	**2,100**

Sources: ABCRC, 2005; BCMB, 2005.

We do not factor in the jobs supported by ABCC in our direct employment benefit calculation as there was a formal domestic beer container collection program before it was mandated as part of the legislation regulating the beverage container stewardship program. Not including the ABCC job estimates, there are approximately 2,065 jobs supported by the beverage container program. The vast majority of these jobs are associated with the depots.

It is not known if the jobs generated by the beverage container stewardship program have led to a reduction in overall unemployment in the province. From a full cost benefit perspective it is important to distinguish between new jobs and a transfer of workers from one sector of the economy to another. It is possible that a portion of the jobs supported by the beverage container stewardship program may have simply been a transfer of jobs caused by a change in how used beverage containers are handled. This is a stronger likelihood in regions of low unemployment. The new jobs may also have come at the expense of potential jobs in other sectors of the economy if the increased expenditure on waste management meant that there was less expenditure in other economic sectors (European Commission, 2001).

A study sponsored by the Directorate-General Environment of the European Commission (2001) concluded that waste management measures are likely to have only a small effect, either positive or negative, on employment. The conclusion challenges the common perception that recycling and other waste management activities stimulate new employment (especially for the socially marginalized or low-skilled workers).

Levels of unemployment in Alberta are at an all-time low. The average unemployment rate in 2004 was 4.6%. Given the lack of workers seeking employment in the province it is difficult to know if the jobs associated with the beverage container stewardship program facilitated employment leading to a decrease in people looking for work.

A conservative estimate of the benefit of employment is to adjust the total employment potential by the unemployment rate to account for job growth that would not otherwise be filled in the economy. In this case we adjust the total direct employment potential by the Alberta unemployment rate of 4.6%. What is not understood for Alberta is what percentage of these jobs were filled by an in-migration of workers. An influx of workers suggests that these jobs were potentially filled by people seeking work. Between the years 2000 and 2005, there was a net increase in inter-provincial migration of 110,000 people to Alberta from other provinces. To account for jobs being filled by an influx of workers we derived a medium and high estimate of the contribution of employment by adjusting the total employment potential by the Canadian average unemployment rate and the unemployment in Newfoundland and Labrador, the province with the highest unemployment rate. The unemployment rates for Canada and Newfoundland and Labrador in 2004 were 7.2% and 15.7% respectively.

Jobs supported by the beverage container stewardship program – 2,065 jobs.

Seasonally Adjusted Average Weekly Earnings: Administrative and support, waste management and remediation services August 2005:
Alberta – $653.10 per week / $33,961 per year (Statistics Canada, 2006e).

Direct employment potential – 2,065 jobs x $33,961 = $70,129,465

Table 34: Direct Employment Impacts of Beverage Container Program

	Low estimate	Medium estimate	High estimate
Direct employment potential	$70,129,465	$70,129,465	$70,129,465
Unemployment rate	4.6%	7.2%	15.7%
Direct employment benefit	$3,225,955	$5,049,321	$11,010,326

- ***Direct employment $ supported by the beverage container stewardship program: $3,226,000 – $11,010,000***
- ***Direct employment benefit per container: $0.002 – $0.008***

4.5.16.1 The Economics of Bottle Collecting

In addition to the direct employment supported by the beverage container stewardship program, there are also financial benefits to those individuals (bottle collectors or bottle pickers) in society who earn an income collecting bottles and returning them for a deposit refund. While no statistical data exists on the level of this economic activity (e.g., number of bottle collectors who earn an income from bottle collection) or the financial benefits (i.e., income) that accrue to bottle collectors, anecdotal evidence does provide some sense of the importance of this activity in society.

In an email interview with Rob Macintosh[11], owner of the Millwoods Bottle Depot in Edmonton, the following economic profile based on anecdotal information was revealed:

- Roughly 25-35% of visits to a depot he used to own in an urban area were bottle pickers (he noted that the percentage is likely much lower at his current suburban Edmonton Millwoods depot where bottle pickers make up less than 5% of clients). Therefore, the number of bottle pickers who frequent depots will vary by location.
- The average volume of beverage containers processed per day that come from bottle pickers is hard to track though Macintosh suggests using an average refund per container of 8 cents.
- The average payout to bottle pickers per day could range from $50-$60 per day based on roughly 2-3 trips or depot visits per day. However, many bottle pickers visit depots irregularly and may also circulate to other depots during the course of a week or month.

Without a more rigorous survey of other bottle depots around the province, it would be difficult to estimate the true economic value of bottle collection activities to both individual bottle pickers and to the well-being of society, in general. Societal benefits include the aesthetic benefits from reduced trash, cleaner streets and alleyways.

4.5.17 Indirect Employment

If direct employment increases, there is a 'multiplier effect' as those newly employed people spend their salaries on goods and services. This stimulates economic activity and can create additional employment in the sectors supplying those goods and services.

A study by R. Beck in 2001 estimated that every job in the recycling industry generates 1.3 spin-off jobs. This estimate has been referenced in other cost benefit analyses including the GPI Atlantic Nova Scotia Solid Waste Resource accounts (2003) which used Beck's estimate as a proxy to determine the benefits of indirect employment and economic spin-off.

There is some evidence to suggest, however, that indirect job estimates of 1.3 per direct job may be high. Similar to the conclusion for direct employment, the Directorate-General Environment of the European Commission study found that the indirect impact and induced impacts of employment are likely minimal given that increased expenditure on waste management often detracts from expenditures in other economic sectors resulting in lost jobs in those sectors. This is known as a 'crowding-out' effect (2001).

The number of indirect jobs supported by the beverage container stewardship program, using the 1.3 indirect jobs per direct job ratio, is 2,065 x 1.3 = 2,684.5 jobs.

Average Weekly Earnings:
Sales and Services Occupations, November 2005:
Alberta – $538.40 per week / $27,997 per year (Statistics Canada, 2006a).

Indirect employment potential: 2,684.5 jobs x $27,997 = $75,157,947

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[11] Email correspondence with Rob Macintosh and Mark Anielski January 7, 2006.

Table 35: Indirect Employment Impacts of Beverage Container Program

	Low estimate	Medium estimate	High estimate
Indirect employment potential	$75,157,947	$75,157,947	$75,157,947
Unemployment rate	4.60%	7.20%	15.70%
Direct employment benefit	$3,457,266	$5,411,372	$11,799,798

- ***Indirect employment benefit supported by the beverage container stewardship program: $3,457,000 – $11,800,000***
- ***Indirect employment benefit per container: $0.003 – $0.009***

4.5.18 Community Investment

Beverage container refunds are used as a source of funding for many community groups. As a specific example, ABCRC directly facilitates the Community Champions Program. This program is designed to help non-profit community groups fundraise. As part of the program, in 2004 the first 'Community Champions Challenge' was held. During the one-month challenge, non-profit community groups were encouraged to return beverage containers. It is estimated that over 1 million containers were returned as part of the challenge equaling over $68,000 paid out to community groups (ABCRC, 2005). By facilitating these types of programs ABCRC builds social and community capital by supporting community based non-profit groups and also by fostering positive relationships in the community.

- ***Community investment benefit: $68,000***
- ***Community investment benefit per container: $0.000***

4.5.19 Community Image / Civic Pride

While it is difficult to measure the impact of the beverage container stewardship program on community image and civic pride given the increasing level of public awareness in the program and fact that Alberta is a leader in recycling suggests that the program contributes positively to the community image.

4.5.20 Environmental Stewardship

The more tangible natural capital benefits of the beverage container stewardship program are captured in such categories as energy savings, reduced GHG emissions, and reduced litter. While more difficult to measure, the beverage container stewardship program provides an indirect benefit by helping to foster an environmental consciousness or ethic based on the principles of resource conservation and environmental protection.

4.6 Comparison with Curbside Alternative Scenarios

If the Beverage Container Management System did not exist in Alberta, beverage containers with the exception of domestic beer containers would most likely be collected through municipal recycling systems, which include both curbside and drop-off programs. (The collection of domestic beer containers would likely still be done by a beer industry affiliated group[12]). In 2002, CM Consulting conducted an in-depth analysis of curbside beverage container collection alternatives, which presented estimated recovery rates for optimum and moderate curbside collection systems. Table 36 presents the potential curbside recovery rates.

Table 36: Alternate System Recovery Rates

	Optimum Curbside	Moderate Curbside	Current System
Aluminum	51%	27%	80.6%
PET	16%	14%	74.2%
HDPE	28%	22%	61.5%
Glass	45%	22%	81.4%

Source: CM Consulting, 2002.

The optimum curbside recovery rates are based on a comprehensive curbside collection system, where 98% of residents have access to curbside recycling. The moderate curbside recovery rates are based on a collection system where approximately 95% of the population has access to recycling opportunities, whether curbside (~40%) or drop-off (~60%). Based on current municipal recycling infrastructure in Alberta, the moderate scenario more closely matches the Alberta reality.

This analysis focuses primarily on comparing the benefits of the different alternatives highlighting those categories which we have included in our study.

4.6.1 Reduction in Greenhouse Gas Benefit

Using the greenhouse gas estimates provided by CM Consulting (2002), Table 37 compares the net greenhouse reduction benefit of the alternate systems.

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[12] Domestic beverage containers, therefore, are not included as part of this analysis.

Table 37: Greenhouse Reduction Benefit – Current System and Curbside Alternatives

Material	Net Emissions Current System (MTCE*)	Net Emissions Optimum Curbside (MTCE)	Net Emissions Moderate Curbside (MTCE)
Glass	(8,546)	(2,163)	(1,057)
PET	(24,947)	(5,377)	(4,705)
HDPE	(523)	(238)	(187)
Other plastic	(81)	(54)	(42)
Aluminum	(63,883)	(22,198)	(11,752)
Steel	(293)	(226)	(110)
Polycoat	(3,194)	(1,600)	(1,257)
Total System	(101,466)	(31,855)	(19,111)

Note: HDPE used as proxy for other plastics, aluminum used as proxy for steel and polycoat.
*metric tonnes of carbon equivalent

Sources: Conversion factors – CM Consulting, 2002; ABCRC, 2005; BCMB, 2005.

The current system provides an increased greenhouse gas benefit of 70,000 MTCE and 83,000 MTCE respectively when compared to the optimum and moderate curbside options. This leads to marginal greenhouse reduction savings (using low GHG value estimates) of $1.9 million when compared to the optimal curbside alternative and $2.2 million when compared to the moderate curbside alternative. Table 38 reviews the marginal difference in greenhouse gas reduction savings using low, medium and high estimates.

Table 38: Marginal Difference in Greenhouse Gas Reduction Savings

Marginal $ savings	Low estimate ($27/tonne CO_2)	Medium estimate ($85/tonne CO_2)	High estimate ($142/tonne CO_2)
Current system vs. optimal curbside alternative	$1,879,000	$5,917,000	$9,885,000
Current system vs. moderate curbside alternative	$2,224,000	$7,000,000	$11,694,000

- ***Marginal Greenhouse gas savings vs. optimal curbside alternative: $1,879,000 – $9,885,000***
- ***Marginal greenhouse gas savings vs. moderate curbside alternative: $2,224,000 – $11,694,000***

4.6.2 Extended Landfill Life Savings

Similar to greenhouse gas reduction benefits, the current system provides significant additional extended landfill space savings in comparison to the curbside options being explored in this analysis. The current system provides additional landfill space savings of 112,000 yd^3 and 153,000 yd^3 when compared to the optimal and moderate curbside alternatives respectively. Table 39 highlights the landfill space savings achieved through recycling under the three scenarios by material type.

Table 39: Extended Landfill Life Benefit – Current System and Curbside Alternatives

Material	Landfill Space Savings Current System (yd^3)	Landfill Space Savings High Curbside (yd^3)	Landfill Space Savings Moderate Curbside (yd^3)
Glass	88,694	49,020	23,965
PET	61,549	13,266	11,608
HDPE	3,206	1,461	1,148
Other plastic	619	417	328
Aluminum	40,572	25,676	13,593
Steel	1,905	1,464	716
Polycoat	13,215	6,618	5,200
Total System	209,759	97,922	56,558

Note: HDPE used as proxy for other plastics, aluminum used as proxy for steel and polycoat.

Sources: Conversion factors - CM Consulting, 2002; ABCRC, 2005; BCMB, 2005.

The marginal dollar savings in extended landfill benefits over the curbside options using conservative cost estimates of landfill space are $4.5 million when compared to the optimal curbside option and $6.1 million when compared to the moderate curbside option.

Table 40 reviews the marginal difference in extended landfill life savings using low, medium and high value estimates.

Table 40: Marginal Difference in Extended Landfill Life Benefits

Marginal Extended Landfill Life Benefits	Low estimate ($40/yd^3)	Medium estimate ($50/yd^3)	High estimate ($61/yd^3)
Current system vs. optimal curbside alternative	$4,473,000	$5,592,000	$6,822,000
Current system vs. moderate curbside alternative	$6,128,000	$7,660,000	$9,345,000

- ***Marginal extended landfill life savings vs. optimal curbside alternative: $4,473,000 – $6,822,000***
- ***Marginal extended landfill life savings vs. moderate curbside alternative: $6,128,000 – $9,345,000***

4.6.3 Energy Savings

The current system offers significant marginal energy savings when compared to the curbside options being explored in this analysis. Table 41 provides estimates for energy savings produced by recycling, expressed in barrels of oil for different system scenarios. The current system provides additional energy savings equivalent to 75,000 and 118,000 barrels of oil when compared to the optimal curbside option and moderate curbside option respectively.

Table 41: Extended Energy Savings Benefit – Current System and Curbside Alternatives

Material	Energy Savings Current System (barrels of oil)	Energy Savings Optimum Curbside (barrels of oil)	Energy Savings Moderate Curbside (barrels of oil)
Glass	5,869	3,244	1,586
PET	27,964	6,027	5,274
HDPE	538	245	193
Other plastic	104	70	55
Aluminum	133,407	84,428	44,697
Steel	253	194	95
Polycoat	1,404	703	552
Total System	169,540	94,912	52,452

Note: HDPE used as proxy for other plastics, aluminum used as proxy for steel and polycoat.

Sources: Conversion factors - CM Consulting, 2002; ABCRC, 2005; BCMB, 2005.

Based on the average price of oil for the year 2004 of $68.97/barrel (Bloomberg, 2005; Bank of Canada, 2006), the additional energy savings of the current system versus the optimal and moderate curbside options are $5.1 million and $8.1 million respectively.

- ***Marginal energy savings benefit vs. optimal curbside alternative: $5,147,093***
- ***Marginal energy savings benefit vs. moderate curbside alternative: $8,075,559***

4.6.4 Litter

The current system when compared to the alternative curbside programs also leads to dramatically less beverage container litter. Table 37 reviews the amount of reduced liter for the various scenarios by material type.

Table 42: Avoided Litter – Current System and Curbside Alternatives

Material	Avoided Litter Current System (# containers)	Avoided Litter Optimum Curbside (# containers)	Avoided Litter Moderate Curbside (# containers)
Glass	1,369,536	756,926	370,053
PET	1,658,668	357,502	312,814
HDPE	55,176	25,139	19,752
Other plastic	10,648	7,183	5,643
Aluminum	3,232,800	2,045,916	1,083,132
Steel	61,226	47,045	23,000
Polycoat	424,710	212,699	167,120
Total System	6,812,764	3,452,409	1,981,514

Note: HDPE used as proxy for other plastics, aluminum used as proxy for steel and polycoat.

Sources: Conversion factors – CM Consulting, 2002; ABCRC, 2005; BCMB, 2005.

- ***Marginal liter reduction vs. optimal curbside alternative: 3,360,255 containers***
- ***Marginal energy savings benefit vs. moderate curbside alternative: 4,831,250 containers***

4.6.5 Air and Water

It is generally understood that recycling reduces emissions of criteria air pollutants. For the purpose of this analysis, however, it is difficult to quantify the potential reductions of the various systems under review as we do not have air and water pollutant impact data by beverage container material type. It can be concluded, however, that because the current system has higher recovery rates than the alternative options, that the current system offers greater air and water pollutant reduction benefits than the curbside alternatives.

4.6.6 Summary

The net marginal increased benefits of the current system in comparison to a curbside blue box recycling program are significant. The current system provides an extra $6 million to $20 million in increased greenhouse gas and energy savings compared to an optimal curbside program. When compared to a moderate curbside program which is more likely to be what Alberta would implement, the increased greenhouse gas and energy savings are even larger, ranging from $9 million to almost $25 million.

Table 43: Marginal Increased Benefit of Current System vs. Curbside Program Alternatives

	Marginal increased benefit of current system	
	vs. optimal scenario (98% access)	vs. moderate scenario (95% access)
Greenhouse gas savings	$873, 618 – $14,158,181	$1,033,555 – $16,750,183
Energy savings	$5,147,093	$8,075,559
Litter reduction	3,360,255 containers	4,831,250 containers

4.6.7 Program Delivery Costs

In terms of straight program delivery costs of a deposit refund based program versus a blue box type program, a comprehensive study commissioned by the organization of Businesses and Environmentalists Allied for Recycling (BEAR) suggests that a deposit refund based program costs 53% less to operate than a moderate curbside collection system (2002). This assumes that revenue from unredeemed deposits and the sale of recycled materials are included as a revenue source for deposit refund based programs. Based on program delivery costs for the Alberta deposit refund system of $70 million, this suggests that a moderate blue box program would come with a price tag of up to $107 million, while resulting in lower diversion rates for beverage containers. However, it is important to consider that curbside alternatives offer diversion of a much wider range of materials than just beverage containers, and any analysis of alternatives must be made within this context.

5 Tires

5.1 Review of Costs and Benefits

In the 2004/2005 fiscal year, Alberta's tire recycling program came with a total price tag of $13.7 million collected through an advance disposal surcharge (ADS) fee paid by consumers on the purchase of all new passenger and truck tires.

Beyond the more readily apparent program costs and the tangible result of recycling 4.16 million passenger tire equivalents (PTE)s[13] during the 2004/2005 fiscal year, there are several other costs and benefits associated with tire recycling in the province. A review of the tire recycling program for the 2004/2005 fiscal year highlights many non-traditional costs and benefits associated with tire recycling.

In Alberta, a $4 ADS fee per tire is paid by consumers when purchasing new passenger and truck tires. Tire retailers remit this fee to Tire Recycling Alberta (TRA) who oversee the program. There are 2,230 tire retailers registered with TRA. Typically when new tires are purchased, the old tires are left with the retailers who store the tires until they are picked up by collectors for delivery to processing facilities.

Cost – 1:	**Administration costs incurred by retailer (collecting $4 fee, bookkeeping work, remitting fee). Retailers are also required to acknowledge the pick-up of scrap tires.**
Cost – 2:	**GHG emissions attributed to the transportation from pick-up points to processors.**
Cost – 3:	**Incentive paid by TRA for tire collection. ($50/tonne or $100/tonnne in northern Alberta).**
Benefit – 1:	**Direct employment (transportation to processing facilities).**

In Alberta, tires are taken to one of two processing facilities. One processor handles passenger and light truck tires and the other processor handles larger truck tires. To avoid sorting tires at retailers, tires are sorted upon delivery to processing facilities and redistributed based on tire type to the appropriate processing location. Tires are processed for rubber crumb or civil engineering uses. Rubber crumb is either sold directly for use in such things as athletic fields and play grounds or used as a feedstock for manufactured products. Incentives are paid by ARMA to processors depending on end use of the product manufactured.

Tire recycling is not a closed loop system, meaning that discarded tires are not recycled back into new tires. Tire recycling, therefore, does not displace virgin tire manufacturing but replaces alternative products.

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[13] PTEs. As tires vary in weight and size, TRA measures the amount of tires using a standardized unit. One PTE equals 10 kg of tire material. There are 100 PTEs in one tonne of tires (ARMA, 2005).

Since the greenhouse gas implications of these alternative products are not known at this time, it is not currently feasible to account for the second-generation GHG emissions being offset as a result of tire recycling. It is important, however, not to disregard the possible impacts of these second generation uses, including their subsequent disposal methods, and further research into these impacts would assist in accurately assessing the full environmental consequences of the program.

It also must be noted that in Alberta, ARMA's incentive program does not pay for tires being burned for fuel, effectively limiting energy-from-waste as an end-use for Alberta's tires.

Cost – 4: **Incentives paid to processors (crumbers, shredders) and manufacturers of end products (e.g., mats, bricks).**

Cost – 5: **GHG associated with tire processing and manufacturing products from recycled tires.**

Cost – 6: **Other environmental impacts associated with processing and manufacturing including air pollution and water use.**

Cost – 7: **Reduced competition in market due to requirements imposed on processors.**

Benefit – 2: **Increase in employment (processing and manufacturing facilities).**

Benefit – 3: **GHG reductions resulting from diversion and beneficial use of tires.**

Benefit – 4: **Extended landfill life by not disposing of tires in landfill including savings by delaying costs associated with siting a new landfill, as well as operational challenges posed by landfilling tires.**

Benefit – 5: **Avoided raw material use of products being replaced by recycled tire product alternative.**

Tire recycling in the province is overseen by Tire Recycling Alberta (TRA), a division of the Alberta Recycling Management Authority (ARMA). In addition to facilitating and overseeing tire recycling, TRA targets the reduction of scrap tire stockpiles, ensures communities benefit from tire recycling, and supports tire recycling research and development.

Cost – 8: **Government regulatory and oversight costs incurred by developing and supporting TRA programming.**

Cost – 9: **Decreased expenditure in other economic sectors due to investment in tire recycling.**

Benefit – 6: **Increase in employment (Tire Recycling Alberta).**

Benefit – 7:	**Reduced environmental and human health liability associated with reducing scrap tire stockpiles.**
Benefit – 8:	**Benefits from investment in communities.**
Benefit – 9:	**Benefits from investment in research and development.**
Benefit – 10:	**Increase in civic pride associated with being a leader in tire recycling.**
Benefit – 11:	**Benefits arising from investment in environmental stewardship including resource conservation and environmental protection benefits.**

5.2 Context of Analysis

This analysis captures the costs and benefits outlined above for the 2004/2005 fiscal year. While there are dangers in taking a static perspective, we are confident that this is not an abnormal year given the maturity of the program and the consistency in recycling revenues, expenditures, and administration costs with previous years. We evaluate the program assuming a counterfactual case of no tire recycling program. Before the program was established in 1992, scrap tires were primarily landfilled or collected in tire stockpiles.

5.2.1 Cost and Benefit Categories

While this analysis attempts to attribute a monetary value to the full range of categories, in several cases due to the lack of data or the inherent difficulty in monetizing social and natural capital, we describe the cost or benefit only. A more detailed description of costs and benefits including how dollar values were estimated are identified in Section 5.6.

Table 44 lists the costs and benefits and the associated evaluation methods of categories included in this review of the tire stewardship program. A list of all categories considered is identified in Section 3.1 and Table 3.

Table 44: Summary of Costs and Benefits of Tire Recycling Stewardship Program

	Evaluation Method	
COSTS:	**Monetary**	**Description**
Program operating costs		
Administration incl. amortization	✓	✓
Recycling development and promotion	✓	✓
Recycling incentives + support to processors and manufacturers	✓	✓
Government costs		
Government regulatory oversight and support	✓	✓
Industry/retail costs		
Supplier/retail sector program support	✓	✓
Environmental costs		
GHG emissions - transportation	✓	✓
GHG emissions - processing and manufacturing	✓	✓
Other environmental impacts	—	✓
Disruption in marketplace		
Reduced competition	—	✓
Employment loss	✓	✓
BENEFITS:		
Resource recovery benefits		
Reduction in GHG emissions	✓	✓
Avoided raw material use	✓	✓
Extended landfill life incl. delayed landfill life siting costs	✓	✓
Reduced environmental and human health liability	✓	✓
Employment		
Direct employment	✓	✓
Indirect employment	✓	✓
Processor + manufacturers		
Expanded economic activity	✓	✓
Community benefits		
Community investment	✓	✓
Civic pride	—	✓
Environmental stewardship		
Resource conservation and environmental protection	—	✓

5.3 Costs and Benefits Valuation

Where feasible we determined a monetary value to the costs and benefits explored in this analysis of the tire recycling program. A low, medium and high range is estimated for most categories. The spread in the range of estimates highlights the inherent challenges in performing full cost/benefit valuation exercises.

Several cost and benefit categories included in the Genuine Wealth analysis were not monetized in our review of the tire program. This was either due to a lack of data to confidently assign a value or simply an acknowledgement that some non-traditional costs and benefits cannot adequately be valued in any meaningful way.

Categories not monetized include:

- Environmental impacts associated with processing tires and manufacturing products from processed tire feedstock.
- Disruption in the marketplace
- Civic pride
- Some resource conservation / environmental protection benefits

A summary of the monetized costs and benefits of the tire recycling program indicate that the program offered a net marginal benefit of between $5.3 million and $35.7 million to Albertans. This is based on estimated program costs of $19.3 million, and program benefits ranging from $24.6 million to $55 million.

The estimated total net marginal benefit per passenger tire equivalent ranges from $1.27 per tire to $8.58 per tire. The estimated benefit per Albertan ranges from $1.62 per Albertan to $10.96 per Albertan. Table 45 provides a summary of the monetized cost and benefits of the tire recycling program.

Table 45: Summary of Monetized Costs and Benefits

Tire Recycling Program Costs and Benefits (fiscal year 2004-2005)	
Program Operating Revenues	
Revenues from ADS (paid by consumers on the purchase of 3.4 million tires)*	$13,680,363
Other revenues/funds (cash start of year, sale of investments, investment income, ADS interest)	$5,900,063
Total Revenues	**$19,580,426**
Program Operating Costs	
Program operating costs	$19,190,287
Recycling incentives	*$11,555,722*
Administration incl. amortization	*$862,042*
Recycling development and promotion	*$6,772,523*
Other Non-Program Societal Costs	
Government support	$50,433
Retail sector program support	$34,323
Disruption in marketplace	$0
Total Program Costs	**$19,275,043**
Tires Recycled (2004)	4,160,000 PTEs
Program costs per tire recycled	$4.63

	Low	**Medium**	**High**
Societal Benefits			
Reduction in GHG emissions	$576,000	$10,063,000	$19,549,000
Avoided raw material use	$7,500,000	$7,500,000	$7,500,000
Extended landfill life	$12,800,000	$16,160,000	$19,520,000
Avoided siting and operational costs	$25,000	$62,000	$99,000
Reduced environmental and human health liability	$600,000	$2,000,000	$2,900,000
Direct employment	$465,537	$728,667	$1,588,899
Indirect employment	$498,561	$780,357	$1,701,612
Expanded economic activity	—	—	—
Community investment	$2,101,000	$2,101,000	$2,101,000
Total Societal Benefits	**$24,566,098**	**$39,395,024**	**$54,959,511**
Net Annual Costs/Benefits	**$5,291,055**	**$20,119,981**	**$35,684,468**
Net Annual Costs/Benefits per tire	**$1.27**	**$4.84**	**$8.58**
Net Annual Costs/Benefits per Albertan**	**$1.62**	**$6.18**	**$10.96**

* The ADS is paid on the purchase of new tires at the point of sale. In 2004 consumers paid the ADS on 3.4 million tires. As the lifespan of tires is longer than one year, the amount of tires purchased and those which can potentially be recycled in a given year do not necessarily match. The difference in number of tires recycled in 2004 (4.2 million PTEs) versus those purchased is also in part due to a concerted effort by ARMA to reduce existing scrap tire stockpiles in the province.

** Assumes a population of 3,256,800. Although this is an average per-capita cost, it is important to note that this is a user-pay program, and as such, the amount paid by individuals varies based on their purchase of tires.

Sources: This summary table synthesizes data from several tables. Please refer to tables in the Cost and benefit descriptions and calculations section for sources.

5.4 Monetary and Physical Description of Cost & Benefit Categories

In addition to attributing a monetary value to cost and benefit categories, this analysis also provides a physical description for each category. Table 46 highlights these results and includes a column identifying who bears the costs and who receives the benefits being described.

Please note that Table 46 is not a cost/benefit summary table. Row results are not commensurable and should not be added up. Monetary estimates and monetary estimates per container speak only to the line item which they reference. A detailed description of each of these line items is provided in Section 5.5. Table 45 (above) provides a summary of the costs and benefits.

Table 46: Cost-Benefit Analysis (Monetary and Physical)

Genuine Wealth Analysis	Monetary	Monetary / pte	Physical
Revenue/Program funds	***ADS: $13,680,363*** ***Investment income: $1,262,978*** ***Sales of investments: $2,580,621*** ***Cash start of year: $2,029,235***		***ADS paid on 3.4 million tires*** ***TRA investment fund = (one year operating reserve is fixed) interest + proceeds above operating reserve go into recycling development.*** ***4.16 million passenger tire equivalents were recycled.***
Pre-program comparison: tires sent to landfill.			
Costs			
Program Operating Costs			
Recycling incentives (money directed to support processing costs)	$11,555,722 **Incentives** Transportation: $50-$100/tonne; Processing: Shred - $100-$195/tonne; Crumb - $110/tonne Manufactured $100/tonne	$2.78	60.2% of total expenditures.
Administration incl. Amortization	$862,042	$0.21	4.5% of total expenditures
Recycling development and promotion	$6,772,523	$1.63	35.3% of total expenditures
Program operating cost subtotal	$19,190,287	$4.61	4.16 million passenger tire equivalents recycled

Genuine Wealth Analysis	Monetary	Monetary / pte	Physical
Non-Program Societal Costs			
Government support	$50,433	$0.01	Ongoing support days - 24/year
Retail sector program support	$34,323	$0.01	Slight administration cost and inconvenience cost: collect $4 fee, book-keeping work, remitting levy, acknowledging pick up of scrap tires.
GHG emissions - processing and manufacturing			Accounted for in overall GHG emissions analysis - see reduction in GHG emissions below.
Other environmental impacts - incl. air pollution and water use			Insufficient data to derive an estimate.
Disruption in marketplace Incl. reduced competition	$0	$0	Requirements for processors may be barrier to marketplace. Board excludes tire-derived fuel (TDF) as a potentially viable end use.
Employment loss	$0	$0	Potential loss of employment at landfills and within municipal collection systems because of reduced volume of material going to landfills.
Benefits			
Societal Benefits			
Reduction in GHG emissions	Range: $576,000 - $19,549,000 ($27/tonne - $142/tonne)	$0.14 - $0.72	Range: 21,000 - 138,000 tonnes eCO_2
Avoided raw material use	$7,500,000	$1.80	100,000 tonnes of washed rock raw materials for bricks, shingles, etc.
Extended landfill life	Range: 12.8 million -$19.5 million (low - $40/$m^3$; medium - $50/$m^3$; high - $61/$m^3$)	*$3.08 - $4.69*	320,000 yd^3
- Avoided siting and operational costs	Range: $24,960 - $98,644 ($0.60/tonne - $2.37/tonne) Values are included in extended landfill life benefit	$0.01 - $0.02	
Reduced environmental and human health liability	Tire fire liability costs: Range $599,500 - $2,076,450 Direct expenditure for scrap tire management = $2,862,118.	$1.10 - $3.81 $0.69	One private site – 500,000 tires 4H Clubs – 45,000 tires

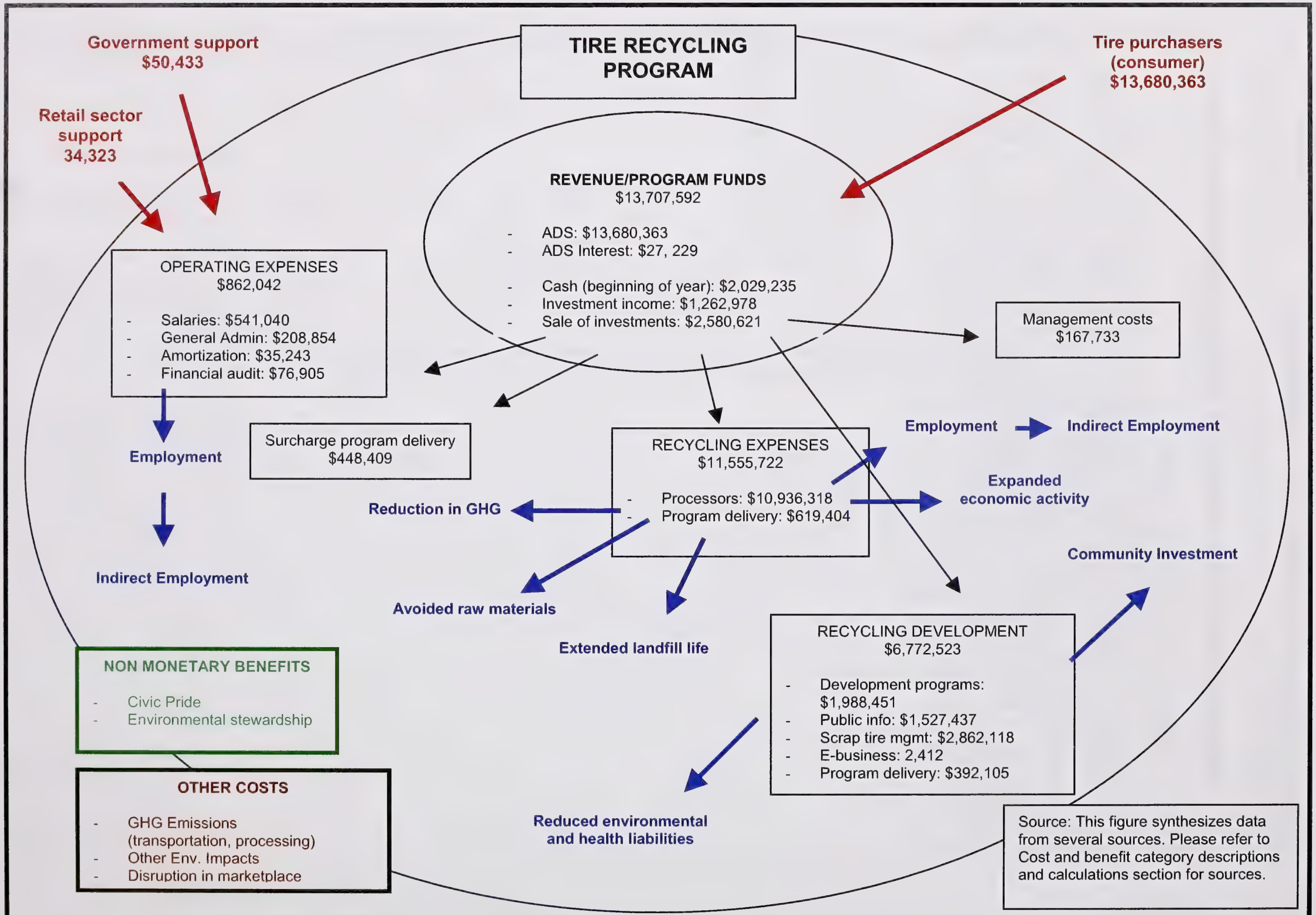
Genuine Wealth Analysis	Monetary	Monetary / pte	Physical
Direct employment	Range: $466,000 – $1,589,000	$0.11 - $0.38	Jobs supported: 298 Average annual salary: $33,961
Indirect employment	Range: $499,000 – $1,702,000	$0.12 - $0.41	Jobs supported: 387 Average annual salary: $27,997
Expanded economic benefits			23% of recycled tires are going into manufactured products. 956,000 PTEs.
Community investment	$2,101,000	$0.51	68 municipal demonstration grants; 31 tire marshalling (landfill) grants; 4H clubs - 45,000 tires collected, Asphalt rubber program - 78 km road paved
Civic pride			Public awareness: 81% Public acceptance: 67%
Resource conservation and environmental protection			

Sources: This summary table synthesizes data from several tables.
Please refer to tables in the cost and benefit descriptions and calculations section for sources.

5.5 Monetary Flow of Tire Recycling Stewardship Program

5.5.1 Monetary Flow Analysis (2004)

The used tire recycling stewardship program is funded by an advance disposal surcharge (ADS) paid on the purchase of all new tires. ARMA supports tire recycling in the province by directing over 60% of the amount collected through the ADS to processors and transporters as recycling incentives. Of the remaining 40%, 35% is directed to recycling development and promotion and 5% goes to cover administration costs. Figure 4 provides a schematic summary of how money flows through the tire recycling system. The value of non-traditional environmental and social cost and benefits are listed in the schematic diagram. To get a sense of the dollar value of these categories please refer to Table 46.


TIRE RECYCLING PROGRAM
Government support $50,433
Retail sector support 34,323
Tire purchasers (consumer) $13,680,363
REVENUE/PROGRAM FUNDS $13,707,592
- ADS: $13,680,363
- ADS Interest: $27, 229
- Cash (beginning of year): $2,029,235
- Investment income: $1,262,978
- Sale of investments: $2,580,621
OPERATING EXPENSES $862,042
- Salaries: $541,040
- General Admin: $208,854
- Amortization: $35,243
- Financial audit: $76,905
Management costs $167,733
Surcharge program delivery $448,409
Employment
Indirect Employment
RECYCLING EXPENSES $11,555,722
- Processors: $10,936,318
- Program delivery: $619,404
Employment
Indirect Employment
Expanded economic activity
Reduction in GHG
Avoided raw materials
Extended landfill life
Community Investment
RECYCLING DEVELOPMENT $6,772,523
- Development programs: $1,988,451
- Public info: $1,527,437
- Scrap tire mgmt: $2,862,118
- E-business: 2,412
- Program delivery: $392,105
Reduced environmental and health liabilities
NON MONETARY BENEFITS
- Civic Pride
- Environmental stewardship
OTHER COSTS
- GHG Emissions (transportation, processing)
- Other Env. Impacts
- Disruption in marketplace

Source: This figure synthesizes data from several sources. Please refer to Cost and benefit category descriptions and calculations section for sources.

Figure 4: Money Flow in Tire Recycling System

5.6 Cost and Benefit Category Descriptions and Calculations

This section reviews each item included in the cost and benefit analysis providing a description of each category. If a monetized value was estimated for the category, an explanation of how the monetized value was estimated is provided.

5.6.1 Costs of Tire Recycling Program

5.6.1.1 Public / Household Costs

5.6.1.1.1 Advance Disposal Surcharge

The public pays an advance disposal surcharge (ADS) fee of $4 per tire on the purchase of new passenger and truck tires. Tire retailers collect the money and pass it on to TRA who use the funds to carry out tire recycling in Alberta. The ADS fee is the direct source of revenue supporting tire recycling in Alberta. While income from investments and the sale of investments supported a portion of the program in 2004/2005, this money is the result of investing a portion of the ADS fee in years past.

There were approximately 3.4 million passenger and truck tires sold in Alberta through 2,230 retailers. It is also noted that the current economic climate in Alberta has led to considerable influx of population, many of whom brought vehicles. These "imported" tires would not have paid the ADS into the program.

Advance disposal surcharge: $13,680,363

5.6.1.1.2 Time

As tires are typically disposed of when new tires are purchased and the environmental handling fee is paid at the point of sale, the direct time to partake in the program is negligible.

Time: $0

5.6.1.1.3 Transportation

Similar to the reasoning above, there are no direct transportation costs borne by the majority of the public to partake in tire recycling. Those who choose to transport their own tires to collection points would have also dealt with their own tires prior to the program.

Household transportation: $0

- ***Total public / household costs: $13,680,363***
- ***Per tire recycled equivalent costs: $3.29[14]***

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[14] The ADS is paid on the purchase of new tires at the point of sale. In 2004 consumers paid the ADS on 3.4 million tires. As the lifespan of tires is longer than one year, the amount of tires purchased and those which can potentially be recycled in a given year do not necessarily match. The difference in number of tires recycled in 2004 (4.2 million PTEs) versus those purchased is also in part due to a concerted effort by ARMA to reduce existing scrap tire stockpiles in the province.

5.6.1.2 Program Operating Costs

The Alberta Recycling Management Authority (ARMA) is responsible for managing Alberta's tire recycling program through its Tire Recycling Alberta (TRA) division.

Legislation authorizes ARMA to levy and collect an advance disposal surcharge (ADS) fee which can be used to:

- Establish and administer waste minimization and recycling programs;
- Education and promotion programs to support waste minimization and recycling;
- Expenditures on the collection, transportation, storage, processing and disposal of designated materials; and
- Research and development activities related to designated materials management.

In the 2004/2005 fiscal year, over $19.5 million in funds were available to support tire recycling. Total expenditures by TRA totaled $19.2 million. Table 47 and Table 48 review program funds and expenditures respectively.

Table 47: Program Funds

	Funds	Percent of total funds
Cash beginning of year	$2,029,235	10.4%
ADS (incl. interest)	$13,707,592	70.0%
Investment income	$1,262,978	6.5%
Sale of investments	$2,580,621	13.2%
Total funds	**$19,580,426**	**100.0%**

Source: ARMA, 2005.

Table 48: Program Expenditures

Category		Expenditure / PTE	Percent of total expenditure
Administration incl. amortization	$862,042	$0.21	4.5%
Recycling incentives	$11,555,722	$2.78	60.2%
Recycling development	$6,772,523	$1.63	35.3%
Total expenditure	**$19,190,287**	**$4.61**	**100.0%**

Source: ARMA, 2005.

As indicated in Table 48, recycling incentives to support tire processors totaled $11.56 million representing 60.2% of total expenditures. $6.8 million went towards recycling development and promotion representing 35.3% of total expenditures. Administration costs totaled ~$860,000 or 4.5% of total expenditures. Table 48 also expresses the program expenditures by expenditure per passenger tire equivalent (PTE). **This indicates that the direct per unit costs incurred by TRA is $4.61 per tire (PTE).**

In sum,

- ***Program operations costs: $19,190,287***
- ***Per tire recycled equivalent costs: $4.61***

It is important when considering the direct costs of program operations to recognize that some of this money is also directly counted as a benefit elsewhere in this full cost and benefit review of the tire recycling stewardship program. For example, money dedicated to supporting community investment in projects using recycled tire material is an investment in social capital and subsequently counted as so.

5.6.1.2.1 Recycling Incentives

Incentives for processors to recycle tires represent the single largest expenditure by TRA. This includes a direct incentive of $2.63 per passenger tire equivalent. Table 49 reviews the total expenditure and expenditure per passenger tire equivalent on recycling incentives.

Table 49: Recycling Incentives Expenditures

Recycling incentives	Total expenditure	Expenditure/ PTE	Percent of total expenditure
Processing incentives	$10,936,318	$2.63	94.6%
Recycling program delivery	$619,404	$0.15	5.4%
Total recycling expenditures	**$11,555,722**	**$2.78**	**100.0%**

Source: ARMA, 2005.

Incentives are paid to processors based on the following components:

- Collection $50/tonne - $100/tonne (North)
- $100/tonne shred produced
- additional $300/tonne crumb produced (residual material is recycled – metal + fiber)
- additional $100/tonne manufactured product produced

5.6.1.2.2 Recycling Development and Promotion

In the 2004/2005 fiscal year, TRA spent almost $6.8 million on recycling development and promotion. This included spending $2.86 million on scrap tire issue management, $1.99 million on recycling development programs, and $1.5 million on public information. Table 50 provides a more detailed breakdown of expenditures on recycling development and promotion by total expenditure and by expenditure per passenger tire equivalent.

Table 50: Recycling Development and Promotion Expenditures

Recycling development and promotion	Total expenditure	Expenditure / PTE	Percent of total expenditure
Recycling development programs	$1,988,451	$0.48	29.4%
Public information	$1,527,437	$0.37	22.6%
Scrap tire issues management (e.g. stockpile reduction)	$2,862,118	$0.69	42.3%
E-Business	$2,412	$0.00	0.0%
Program delivery	$392,105	$0.09	5.8%
Total recycling development	**$6,772,523**	**$1.63**	**100.0%**

Source: ARMA, 2005.

5.6.1.2.3 Administration

Administration costs represent 4.5% of TRA's total expenditures of ~$862,000. As indicated in Table 51, approximately 63% of this amount went towards salaries and related expenses.

Table 51: Administration Expenditures

Administration	Total expenditure	Expenditure / PTE	Percent of total expenditure
Salaries and related expenses	$541,040	$0.13	62.8%
General administration expenses	$208,854	$0.05	24.2%
Amortization	$35,243	$0.01	4.1%
Financial audit	$76,905	$0.02	8.9%
Operation expenditures	**$862,042**	**$0.21**	**100.0%**

Source: ARMA, 2005.

5.6.1.3 Government Support Costs

The tire recycling program is operated by ARMA, a delegated administrative organization (DAO), which operates at arms length from government. At the start up of the program, however, there was a significant amount of government support to develop and introduce the program. There is ongoing support in the form of assistance to encourage program development.

Based on estimates provided by Alberta Environment, program development and launch costs totaled roughly $210,000 in staffing time and $350,000 in consulting fees paid by the government. If we distribute this amount over the length of program operation (13 years), it equals $43,077 per year.

On-going support is estimated at two days per month in total staffing time. This includes the combined time allocated by program staff, managers, and the assistant deputy minister. Assuming an $80,000 annual salary and 261 workdays per year this equals ongoing government support costs of $7,356.32.

- ***Government support costs: $50,433.24***
- ***Per tire recycled equivalent costs: $0.01***

5.6.1.4 Retail Support Costs

Retailers do not support the program directly. There is a slight administration function incurred by tire retailers including collecting the $4 ADS fee, remitting the fee to ARMA and the associated book-keeping work. Retailers are also required to temporarily store and acknowledge the pick-up of used tires suggesting a potential nuisance cost, although it could be argued that this cost would also exist in absence of a program.

Based on a brief questionnaire to a small sample of retailers we estimate the increased time burden on retailers to support the program at 2.7 seconds per tire. This estimate is based on examples of monthly time allocated to support the program divided by the number of tires handled. Table 52 highlights sample retailer findings. We estimate the time allocated based on tire sales under the assumption that retailers recover approximately the same amount of used tires as new tires they sell.

- Total time invested by retailers = 2.7 seconds X 3.4 million tires
- Total time = 2,550 hours

Table 52: Sample of Tire Retailer Support

Tire Business/ Phone Number/Contact	Administration Time (monthly)	How many tires sold annually?	Other costs associated with tire fee?	Comments
Blaskin Lane #1	5 minutes	Not sure	None	-Automated* -Head office sends payment to ARMA -Collector comes weekly
Blaskin Lane #2	5-10 minutes	1,000	None	-Automated* -Head office sends payment to ARMA -Collector comes weekly
Fountain Tire	30 minutes	4,000	None	-Automated* -Head office sends payment to ARMA -Collector called as required
Kal Tire #1	20 minutes	4,000 (2005)	None	-Automated* -Send cheques monthly to ARMA -Call collector when tire cage is full
Kal Tire #2	15 minutes	Over 10,000	None	-Automated*
OK Tire	5 minutes	2,000	None	-Automated* -Collector comes by automatically

*Advanced disposal fee automatically added to invoice

Calgary Tire Businesses (Called February 1, 2006)

If we multiply the total hours invested by retailers to support the program by The average hourly earnings of those employed in Sales and Services Occupations (November 2005) for Alberta we get: 2,550 X $13.46 = $34,323.

- ***Retailer support costs: $34,323***
- ***Per tire recycled equivalent costs: $0.01***

5.6.1.5 Disruption in Marketplace

According to an Environment Canada review of extended producer responsibility and stewardship programs in Canada, tire recycling in Alberta operates on a level playing field. This is attributed to the fact that the program is consistent throughout the province and that the program starts at the retail end (2002). All processors and manufacturers are paid equally according to the recycling end product. Furthermore, TRA funds recyclers based on the material successfully recycled. There are no loans, loan guarantees, start up grants or bail-outs.

The terms of condition to become a processor could have the potential to restrict entry into the marketplace. TRA requires prospective processors to post a $50,000 performance bond and have a plan to process a minimum of 500 tonnes of material annually. These terms of condition are in place as a quality control measure to ensure that TRA only supports legitimate processors.

ARMA does not provide an incentive for tires to be burned for fuel or shredded and landfilled, effectively limiting these options as a disposal method. Tire derived fuel (TDF) markets, however, are the most profitable markets for scrap tires in the world (Bearing Point, 2005).[15] With increasing fuel prices, the value of TDF markets will likely continue to rise. While ARMA policy discourages TDF, it applies consistently throughout the province.

Previous to the program, tires were landfilled and therefore there was no pre-existing marketplace or tire recycling infrastructure. Given that tire recycling on an annual basis diverts approximately 40,000 tonnes of material from landfills there may be a loss of employment at landfills and within municipal collection systems because of reduced volume which can be attributed to the program. To keep this in perspective, however, the amount of material being diverted by recycling tires represents only 1% of the total material being disposed of in landfills in Alberta. As such, we assume that there are no direct job losses which can be attributed to tire recycling.[16]

- ***Disruption in marketplace costs: $0***

5.6.1.6 Processing Costs

The direct processing costs of recycling are accounted for in this analysis under program operations (see above). TRA paid out over $10.9 million to recyclers. There are indirect costs, however, associated with processing not included in that amount.

5.6.1.6.1 GHG Emissions – Processing and Manufacturing

While there are GHG emissions associated with processing and manufacturing used tires, tire recycling generates an overall greenhouse gas savings. This analysis does not break out GHG costs and benefits by component but uses the summary level findings from the ICF Consulting report (2005) prepared for Environment Canada and NRCan. Estimates based on this report suggest an overall savings of between 0.5 and 3.31 tonnes of equivalent CO_2/tonne of tires recycled, as compared to landfilling. This is discussed further in the GHG emissions benefit component below.

5.6.1.6.2 Other Environmental Impacts – Processing and Manufacturing

As tire recycling is not a closed loop system, the benefits of the alternate uses of recycled tires and the environmental costs of processing tires and manufacturing recycled product need to be understood to properly assess the overall environmental implications of the program. While we are not attaching a value to this category given the lack of available data, it is important to highlight that to better understand the full environmental cost, ARMA or Alberta Environment may wish to undertake additional research on environmental impacts or undertake an environmental audit of processing and manufacturing products from used tires.

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[15] According to the Bearing Point study (2005), in 2003, a total of 130 million tires were consumed in TDF applications in the U.S. and a further 98 million PTEs (0.8 million tonnes) were used as fuel in the European Union.

[16] In 2002, 2.9 million tones of material were disposed of in landfills or through incineration (Statistics Canada, 2002).

5.6.2 Benefits of Tire Recycling Program

5.6.2.1 Reduction in Greenhouse Gas Emissions Benefit

The ICF Consulting report (2005) prepared for Environment Canada and NRCan estimates an overall savings of 3.31 tonnes of equivalent CO_2/tonne of tires recycled, as compared to landfilling. However, this value is specifically for retreading, which can be argued to be more of a reuse activity. The report also presents a benefit of (0.5) tonnes eCO_2 for combustion of one tonne of tires.

The recycling of tires into manufactured products does not displace the manufacture of new tires, but rather replaces alternative products. Since the greenhouse gas implications of these alternative products are not known, it is not possible to develop comprehensive estimates of greenhouse gas emission reductions associated with recycled tire products.

In addition, a large portion of Alberta's tires are destined for civil engineering applications, replacing materials like aggregate. The GHG impacts associated with this substitution are also not understood.

Therefore, for the purposes of this report, a range of values will be utilized to present the potential GHG benefits associated with Alberta's tire recycling program. Essentially, it is assumed that the GHG reductions associated with the various destinations of tires diverted through the program will range between the values identified for combustion and retreading.

4.16 million passenger tire equivalents were collected through the program in 2004/05, or 41,600 tonnes of tires. Using the range of values above, this translates into greenhouse gas emissions reductions of between 21,000 and 138,000 tonnes eCO_2.

This report estimates a high end per tonne eCO_2 value based on the social cost of carbon used in Britain's Stern Review on the Economics of Climate Change (2006). The review calculates the damage done over time by a tonne of CO_2 emitted this year, if the world continues on a business-as-usual (BAU) scenario. The social cost of carbon under the BAU is estimated at US\$85/tCO_2 (2000\$) now, and rising over time. We converted the current value as C\$142/tCO_2 (2005\$). It is important to note that the Stern Review is based on the latest science, which predicts greater increases in global average temperature (at least 5 degrees Celsius, compared with previous estimates of 2-3 degrees Celsius).

As a low end per tonne eCO_2 value we use the European carbon trading market value which we estimate at C\$7.48/tC (4.37 Euros/tC) based on April 4, 2006 trading values. This translates to C\$27/tCO_2. We recognize that the true value may very well fall in between these limits and therefore as a middle value estimate selected the mid point between the Stern Review cost of carbon value and the European carbon trading market value. The proposed middle estimate is \$85/tonne eCO_2.

Table 53 highlights possible greenhouse gas reduction savings based on the established value per tonne eCO_2 range being used for this report.

Table 53: Greenhouse Gas Reduction Savings Estimates

Estimated GHG $ reduction benefits	Low estimate ($27/tonne CO_2)	Medium estimate ($85/tonne CO_2)	High estimate ($142/tonne CO_2)
GHGs avoided (low impact scenario)	21,000	21,000	21,000
Total benefit	$576,000	$1,776,000	$2,975,000
Benefit per tire recycled	$0.14	$0.43	$0.72
GHGs avoided (high impact scenario)	138,000	138,000	138,000
Total benefit	$3,788,000	$11,669,000	$19,549,000
Benefit per tire recycled	$0.91	$2.81	$4.70

- ***Greenhouse gas reduction benefit: $576,000 - $19,549,000***
- ***Greenhouse gas reduction benefit per tire recycled equivalent: $0.14 - $0.72***

5.6.2.2 Avoided Raw Materials Benefit

As indicated, used tires are not recycled back into new tires but are recycled into other end uses. While recycling tires therefore does not offset the raw materials to manufacture new tires, it does displace other raw materials.

For example, in 2004, approximately 25,000 tonnes of shredded tire material was used for leachate collection systems, saving 100,000 tonnes of washed rock. This provides a direct savings of more than $1.5 million in avoided washed rock purchase costs, plus the additional cost to transport heavy rock over the much lighter tire shred material. The benefits also extend beyond the direct costs, as using shredded tire material prevented 100,000 tonnes of washed rock from being mined and processed, and may offer superior performance characteristics. Since 1992, 680,000 tonnes of washed rock has been replaced by shredded tire material. ARMA estimates that this has led to a direct savings of $35 million. This translates to a savings of over $50/tonne of displaced rock.

In 2004, an additional 16,600 tonnes of rubber crumb was used directly in crumb applications such as for playground surfaces or as feedstock for manufactured products. Manufactured products made by rubber crumb include molded bricks, anti-fatigue mats, rig mats and dairy mattresses. While it is difficult to determine the amount and value of the raw materials replaced by crumb, the market value of the crumb totalled $2.5 million, suggesting this as a reasonable proxy value.

5.6.2.2.1 Direct Avoided Raw Material Savings (2004)

Avoided use of washed rock: $5,000,000
Use or recycled crumb: $2,500,000

- ***Avoided raw material savings: $7,500,000***
- ***Per passenger tire equivalent recycled costs: $1.80***

Again, this estimate does not include the avoided extraction, processing, and transportation costs of replacing raw materials. It refers only to the estimated market value of the avoided materials. This is clearly a significant under-representation of the true savings achieved by replacing raw materials with recycled alternatives.

5.6.2.3 Extended Landfill Life

5.6.2.3.1 Disposal Costs

In assessing a reasonable value for landfill cost, it could be argued that landfills operated by the private sector are profit driven and may better reflect actual costs. Essentially, the operations of a private-sector company are bound to be profitable by the expectations of its shareholders. Therefore, private landfill operators must account for all direct and potential costs associated with their operations. It is reasonable, then, to suggest that the rates charged by private landfills are a good proxy of the full costs, excepting those costs borne by society as a whole.

Discussions with Waste Management Inc., have concluded that the average gate rate at a private landfill is approximately $42/tonne (Hantiuk, 2006).

An average of landfill tipping fees across Alberta as reported to Alberta Environment in 2005 was $37/tonne. This suggests a similar range to the private sector costs above.

It is often asserted by waste reduction advocates that the costs of landfill disposal are generally underestimated, and that the full costs of operating a landfill are not reflected in the tipping fee. By not accounting for the full costs of landfill disposal, alternative measure such as recycling and composting are placed at an economic disadvantage.

In many cases, only direct capital and operating costs are taken into account when determining landfill costs. It is recognized that indirect costs, including health risks, property value depreciation, environmental risks, lost opportunity and quality of life must also be taken into account (AOW, 1995).

The $42/tonne disposal estimate for private landfills does not include costs borne by society in general, potentially neglected future siting costs, unanticipated closure and post closure costs, nor the nuisance costs and potential loss of property value costs borne by neighbouring residents and potential future environmental pollution risks.

A University of Toronto Department of Economics report on municipal user fees suggested that the net marginal social costs for landfill disposal were in excess of $50/tonne in the Toronto region, while as low as $30/tonne in other regions of Canada (Dewees, 2002). Adding these social costs would suggest a full valuation of landfill at $72-$92/tonne.

Compacted garbage has a density of 1,200-1,500 pounds/yd^3 (CSR, 2003). Based on this, one tonne of garbage takes up 1.5-1.8 yd^3. Therefore, a landfill cost of $72/tonne would translate into approximately $40-$48/yd^3, whereas $92/tonne would equate to $51-$61/yd^3.

Therefore we estimate a landfill disposal cost range of:

- Low: $40/yd^3
- Medium: $50/yd^3
- High: $61/yd^3

In 2004, there were 4.16 million tires recycled which translates into approximately 320,000 yd^3 of saved landfill space. Using a landfill disposal cost range of between $40/m^3-$61/m^3 equals a savings of $9,280,000-$11,136,000.

- ***Extended landfill life savings: $12.8 million – $19.5 million***
- ***Per tire recycled equivalent costs: $3.08 – $4.69***

5.6.2.3.2 Avoided Siting Costs

The above extended landfill life values have factored in avoided siting costs. To demonstrate the significance of siting costs we have separated this component out. The following list overviews costs examples associated with siting a landfill referenced in the GPI Atlantic cost benefit analysis of the Nova Scotia solid waste system.

- Regional District of Kootenay, BC – $3-$4 million
- Ontario Municipalities (research and siting costs) – $2.16/tonne (2000$)
- Halton, Ontario – $2/tonne (1996$)
- Landfills serving large municipalities. – $1.43-$1.58/tonne (1996$)
- Otter Lake facility serving Halifax Regional Municipality – $0.55/tonne (2000$)

The values referenced in the GPI Atlantic report give an avoided siting cost range of $0.55/tonne to $2.16/tonne (2000$). Updating these values to 2004$ using the consumer price index gives a range of $0.60/tonne to $2.37/tonne.[17]

- ***Avoided siting costs savings: $25,000 – $99,000***
- ***Per passenger tire equivalent recycled costs: $0.01 – $0.02***

5.6.2.4 Reduced Environmental and Human Health Liability

Scrap tire piles pose a significant environmental and human health liability. The most notable liabilities include tire fires and potential for human health disease outbreaks caused by rodents and mosquitoes. Recycling tires offers an alternative end use for tires reducing the potential of tire pile build-ups.

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[17] The consumer price index between 2000 and 2004 increased by 9.8% (Statistics Canada, 2006).

As part of the tire recycling program, ARMA monitors sites where build-ups occur as a result of the recycling process. For example, ARMA monitors processors to prevent excessive inventory build ups from occurring and to ensure that storage of tires conform to the Alberta Fire Code. ARMA is also committed to reducing private tire stockpiles. In 2004, a major stockpile reduction project resulted in over 500,000 scrap tires from a private stockpile in southern Alberta being loaded, transported and processed (ARMA, 2005).

ARMA spent $2.86 million on scrap tire management to clean up tire stockpiles during the 2004-2005 fiscal year (ARMA, 2005).

5.6.2.4.1 Fire

While major tire fires are rare, the environmental and human health costs are significant. According to a 2002 Environment Canada study on Extended Producer Responsibility and Stewardship, most tire recycling management programs in Canada were started out of concern over the Saint Amable, PQ and Hagersville, ON tire fires in 1990. Similarly, in the United States, it was the devastating impacts from the Rhinehart, VA tire fire in 1983 that prompted the development of many tire recycling and scrap tire management programs. Fire from the Rhinehart, VA incident smouldered for six months causing significant air pollution. The oily tar also contained benzene, ethylbenzene, toluene, anthracene, naphthalene, pyrene, cadmium, chromium, nickel, and zinc which contaminated surface water and the local aquifer. The site was designated a National Priority List superfund site and remained on that list until September 2005, 22 years after the fire (EPA, 2005).

5.6.2.4.2 Hazards

The average passenger car tire is estimated to produce over 2 gallons of oil when burned. Oil runoff from fires can contaminate soils, surface water and ground water. According to a report by the Rubber Manufacturers Association (2003) on the prevention and management of scrap tire fires, if half of the burned tires in the Hagarsville, Ontario fire were liquefied an estimated 14 million gallons of toxic oil could have been leached into the soil of nearby farmlands (as noted in the report, the Exxon-Valdez incident spilled 11 million gallons of oil).

The air emissions produced in a tire fire are also extremely hazardous. According to an EPA report (Reisman and Lemieux, 1997) on air emissions from tire fires,

> "open tire fire emissions include "criteria" pollutants, such as particulates, carbon monoxide (CO), sulfur oxides (SO), oxides of nitrogen (NO), and volatile organic compounds (VOCs). They also include "non-criteria" hazardous air pollutants (HAPs), such as polynuclear aromatic hydrocarbons (PAHs), dioxins, furans, hydrogen chloride, benzene, polychlorinated biphenyls (PCBs); and metals such as arsenic, cadmium, nickel, zinc, mercury, chromium, and vanadium. Both criteria and HAP emissions from an open tire fire can represent significant acute (short-term) and chronic (long-term) health hazards to firefighters and nearby residents. Depending on the length and degree of exposure, these health effects could include irritation of the skin, eyes, and mucous membranes, respiratory effects, central nervous system depression, and cancer" *(p. viii-ix).*

Table 54 overviews the direct costs of a selection of major tire fires in North America. Direct costs of the Haggersville and the St. Amable tire fires were estimated to be over $10 million (1990$) respectively. This suggests a major tire fire liability cost range of $0.83 per tire to $2.86 per tire. Updating these estimates to 2004$ using the consumer price index gives a range of $1.10 per tire to $3.81 per tire.[18]

In 2004-2005 fiscal year there were at least 545,000 stockpiled tires processed. Based on our avoided fire liability cost range **this suggests an avoided liability savings of $545,000 to $1,558,700.**

Direct costs are a crude estimate of the true environmental costs of tire fires as they account for only the market costs of responding to the fire and cleaning up the localized environment. Non-localized, long term, and non-human liabilities are not considered in these estimates.

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[18] The consumer price index between 1990 and 2004 increased by 33.5% (Statistics Canada, 2006).

Table 54: Estimated Direct Costs of Selected Major Tire Fires in North America

Location	Date	# of tires	Costs	Source
Westley, CA	1999	7 million	EPA response costs: $3.5 million Overall costs of site remediation: $15 million	EPA Oil Program. Abstract of EPA response to Westley, California Tire Fire. Available at www.epa.gov/oilspill/pdfs/tirefire.pdf. Accessed December, 2005.
Tracy, CA	1998	8 million	Tracy fire department - $450,000 Overall costs of site remediation: $12 million	Slaughter, Rodney. 2004. Tire Fire Prevention and Suppression Instructor guide lesson 10 derived from "Rings of Fire: Tire Fire Prevention and Suppression." California State Fire Marshal. Instructor guide is available at http://osfm.fire.ca.gov/pdf/regulations/LP10HAZMAT.pdf. Accessed December, 2005.
Hagersville, ON Tyre King Dump	1990	12-15 million	fire department - $1.5 million Damage to infrastructure - $3 million Overall costs – over $10 million	CBC News Archives. The Hagersville Tire Fire. Broadcast February 12th, 1990. Rubber Manufacturers Association. 2003. The Prevention And Management of Scrap Tire Fires. Available at www.rma.org/scrap_tires/. Accessed December 2005. CBC News Archives. Disclosure: Tired Out. Broadcast March 19th, 2002.
St-Amable, PQ	1990	3.5 million	$10 million Designated an Emergency Measures Situation.	Cost estimate from: Environment Canada Extended Producer Responsibility and Stewardship. 2002. An Inventory of Waste Diversion Programs in Canada - Part 1: Programs Funded in Whole or in Part by Industry and Consumers. Maclean's. 1990. The fire mountain: battling the blaze at a Quebec tire dump. May 28, 1990: 103 (22): 50.
Rhinehart, VA	1983	5-7 million	EPA response costs: $1.74 million to control and collect 800,000 gallons of oil wastes. Designated a superfund site.	EPA. National Priority List. Federal Register Notices. Available at www.epa.gov/superfund/sites/npl/d050930.htm. Accessed December 2005.

5.6.2.4.3 Rodents / Mosquitoes

Tires are a potential breeding ground for rodents, mosquitoes and other insects. Reducing stockpiles offers an immediate defense strategy to limit the liability of potential health outbreaks. The potential of tire stockpiles to provide a breeding ground for mosquitoes capable of transmitting West Nile Virus is a recent health concern in Alberta.

In addition to ARMA's goal of reducing scrap tire piles, ARMA tested mosquito larvae for the presence of West Nile Virus in tire piles at processing facilities. In 2004, all tests came back negative (ARMA, 2005). However, this continues to be a health concern presented by scrap tire stockpiles.

5.6.2.4.4 Reduced Environmental and Human Health Liability

It is difficult to determine a specific dollar estimate in avoided risk savings by reducing tire stockpiles. It is important to remember, however, as noted above that the driver for most, if not all, tire recycling programs in Canada was the recognized dangers of a serious stock piled tire fire. Money directed at reducing the potential liability of stock piled tires therefore is seen as a preventive expenditure. As such we established a reduced environmental and human health liability savings range based on the avoided tire fire liability savings outlined above and the direct money spent by ARMA on stockpile tire management.

Table 55: Reduced Environmental and Human Health Liability Savings

	Low estimate	Medium estimate	High estimate
Estimated Savings	$600,000	$2,000,000	$2,900,000

- ***Environmental and human health liability savings: $600,000 – $2,900,000***
- ***Per passenger tire equivalent recycled costs: $0.14 – $0.69***

5.6.2.5 Direct Employment

For the 2004/2005 fiscal year, ARMA estimated that 298 jobs were supported by the tire recycling program. This includes employment at ARMA in which some employees have an overlap of responsibility between the tire recycling program and electronics recycling program. A 2002 Environment Canada report on extended producer responsibility programs in Canada indicates that tire recycling in Alberta supports 250 jobs. This gives Alberta a job-per-tire-recycled ratio of 1:11,400. This is similar to ratios in Manitoba and New Brunswick. Provincial estimates provided in the Environment Canada report range from a high job-per-tire-recycled ratio of 1:5,600 in Saskatchewan to a low job-per-tire-recycled ratio of 1:18,000 in Nova Scotia.

It is not known if the jobs generated by the tire recycling program have led to a reduction in unemployment in the province. From a full cost benefit perspective it is important to distinguish between new jobs and a transfer of workers from one sector of the economy to another. It is possible that a portion of the jobs supported by the tire recycling program may have simply been a transfer of jobs caused by a change in how tires were handled. This is a stronger likelihood in regions of low unemployment. The new jobs may also have come at the expense of potential jobs in other sectors of the economy if the increased expenditure on waste management meant that there was less expenditure in other economic sectors (European Commission, 2001).

A study sponsored by the Directorate-General Environment of the European Commission (2001) concluded that waste management measures are likely to have only a small effect, either positive or negative, on employment. The conclusion challenges the common perception that recycling and other waste management activities stimulate new employment (especially for the socially excluded or the low skilled).

Levels of unemployment in Alberta are at an all time low. The average unemployment rate in 2004 was 4.6%. Given the lack of workers seeking employment in the province it is difficult to know if the jobs associated with the tire stewardship program facilitated employment leading to a decrease in people looking for work.

A conservative estimate of the benefit of employment is to adjust the total employment potential by the unemployment rate to account for job growth that would not otherwise be filled in the economy. In this case we adjust the total direct employment potential by the Alberta unemployment rate of 4.6%. What is not understood for Alberta is what percentage of these jobs were filled by an in-migration of workers. An influx of workers suggests that these jobs were potentially filled by people seeking work. Between the years 2000 and 2005, there was a net increase in inter-provincial migration of 110,000 people to Alberta from other provinces. To account for jobs being filled by an influx of workers we derived a medium and high estimate of the contribution of employment by adjusting the total employment potential by the Canadian average unemployment rate and the unemployment in Newfoundland and Labrador, the province with the highest unemployment rate. The unemployment rates for Canada and Newfoundland and Labrador in 2004 were 7.2% and 15.7% respectively.

Jobs supported by the Tire Recycling Program – 298 jobs

Seasonally Adjusted Average Weekly Earnings:
Administrative and support, waste management and remediation services
August 2005: Alberta – $653.10 per week / $33,961 per year.

Direct employment potential: $ – 298 x $33,961 = $10,120,378

Table 56: Direct Employment Benefits of Tire Recycling Program

	Low estimate	Medium estimate	High estimate
Direct employment potential	$10,120,378	$10,120,378	$10,120,378
Unemployment rate	4.60%	7.20%	15.70%
Direct employment benefit	$465,537	$728,667	$1,588,899

- ***Direct employment benefit supported by the tire recycling stewardship program: $466,000 – $1,589,000***
- ***Direct employment benefit per passenger tire equivalent recycled: $0.11 – $0.38***

5.6.2.6 Indirect Employment

If direct employment increases, there is a 'multiplier effect' as those newly employed people spend their salaries on goods and services. This stimulates economic activity and can create additional employment in the sectors supplying those goods and services.

A study by R. Beck in 2001 estimated that every job in the recycling industry generates 1.3 spin-off jobs. This estimate has been referenced in other cost benefit analysis including the GPI Atlantic Nova Scotia Solid Waste Resource accounts (2004) which used Beck's estimate as a proxy to determine the benefits of indirect employment and economic spin-off.

There is some evidence to suggest, however, that indirect job estimates of 1.3 per direct job may be high. Similar to the conclusion for direct employment, the Directorate-General Environment of the European Commission study found that the indirect impact and induced impacts of employment are likely minimal given that increased expenditure on waste management often detracts from expenditures in other economic sectors resulting in lost jobs in those sectors. This is known as a 'crowding-out' effect (2001).

The number of indirect jobs supported by the Tire Recycling Program if we use the 1.3 indirect jobs per direct job ratio is 298 x 1.3 = 387.

Average Weekly Earnings:
Sales and Services Occupations, November 2005, Alberta – $538.40 per week / $27,997 per year.

Indirect employment potential: $ – 387 x $27,997 = $10,838,290

Table 57: Indirect Employment Benefits of Tire Recycling Program

	Low estimate	Medium estimate	High estimate
Indirect employment potential	$10,838,290	$10,838,290	$10,838,290
Unemployment rate	4.60%	7.20%	15.70%
Indirect employment benefit	$498,561	$780,357	$1,701,612

- ***Indirect employment benefit supported by the tire recycling stewardship program: $499,000 – $1,702,000***
- ***Indirect employment benefit per passenger tire equivalent recycled: $0.12 – $0.41***

5.6.2.7 Expanded Economic Activity

The incentive based approach to the tire recycling stewardship program has helped create and support end use markets for used tires. ARMA estimates that the value of product sales by the users of recycled material is ten times the amount that ARMA invests (ARMA, 2005. Personal Communication with Doug Wright).

In 2004/05 the breakdown of recycled tire by end use was as follows:

- 60% (2,496,000 PTE) were shredded for civil engineering purposes;
- 17% (707,200 PTE) were processed and sold as rubber crumb;
- 23% (956,800 PTE) were used as a feedstock for manufactured products.

Table 58 highlights the end use of recovered tires by percentage since the 1996/1997 fiscal year.

Table 58: Recycled Tire End Use

	Manufactured Product	Rubber Crumb	Civil Engineering	Tire-Derived Fuel
1996/97	9%	21%	43%	27%
1997/98	21%	21%	50%	8%
1998/99	14%	25%	61%	—
1999/00	22%	39%	39%	—
2000/01	11%	43%	46%	—
2001/02	19%	35%	46%	—
2002/03	20%	34%	46%	—
2003/04	17%	29%	54%	—
2004/05	23%	17%	60%	—

Source: ARMA, 2002; ARMA, 2005.

5.6.2.8 Manufactured Products

Recycling tires into other manufactured products extends the economic life of used tires. Current manufactured products made from used tires include: molded bricks, anti-fatigue mats, dairy mattresses, rig mats, and roofing shingles. By emphasizing value added manufacturing, TRA / ARMA is striving to generate greater economic value from recycled tires and further the economic sustainability of tire recycling. The percentage of recycled tires being used as manufactured product has increased from 9% in 1996/97 to 23% in 2004/05 (see Table 58).

Manufactured products do however reenter the waste disposal stream and often end up in the landfill. The full environmental impacts of manufacturing products from recycled material are not well understood.

5.6.2.9 Community Investment

As part of its mandate TRA is committed to ensuring that tire recycling occurs in an environmentally and socially responsible manner. As such TRA is committed to ensuring that Alberta communities benefit from tire recycling.

TRA directly invests in communities through several programs.

1) Community Centennial Grant Program: This program provides funds to communities that incorporate recycled tire products into community enhancement projects. TRA will subsidize up to 50% of the project and contribute a maximum of $5,000 in installation costs.
2) Tire Marshalling Area Program: This program provides money to municipal landfills throughout the province so they can better handle scrap tires that enter their landfill.
3) 4-H Clubs program: This program provides a monetary incentive to 4H clubs to round up scrap tires. An incentive of 75 cents is paid per passenger tire equivalent and $3 per off-the-road tire.
4) Asphalt rubber program: The asphalt rubber program is an arrangement with municipalities to use crumb in asphalt assisting them in paving streets. TRA has committed $1 million per year for 5 years.

Table 59 overviews the number of projects and the total amount of money directly received by communities as a result of these programs.

Table 59: Community Investment Programs

Initiative	# of projects	Investment
Municipal Demonstration Program[19]	2004: 68 projects Since 2000: 160 projects	2004: $526,000 Since 2000: 3.8 million
Tire Marshalling Area Program	2004: 31 landfills	2004: $500,000
4-H clubs	2004: Collected 43,000 tires	2004: $75,000
Asphalt rubber program	2004: 78.2 km lane road paved 14 projects	2004: $1,000,000
Total (2004)		**$2,101,000**

Source: ARMA, 2005.

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[19] 2005-2006 community grant recipients: Canterbury Foundation; Chestermere Regional Community Association; Crossing Park School Society; Delwood Community League; Evergreen Regional Waste Management Services Commission; Friends of Bearspaw Education Society; Hardisty Agricultural Society; Kenilworth Community League; Nampa & District Agricultural Society; Spirit River Friends of Ste. Marie Committee; St. Mary School; The Royal Canadian Legion, Branch 238, Bowness; Town of Athabasca; Town of Bashaw; Town of Nanton; Town of Ponoka; Village of Hythe; Willow Creek Agricultural Society; Afton Parent Advisory Council.
Note: other municipalities that submitted applications will receive grants in the 2005-06 year once the final program requirements have been completed and submitted to ARMA.
On the Edge Recreational Society; Picture Butte Fish and Game Association; Playground Pals; Rio Terrace Park Redevelopment; Rocky Ridge Ranch Home Owner Association; Chinook Park School Courtyard Project; Alberta Provincial Rifle Association; Medicine Hat Exhibition & Stampede Company Ltd.; Lac La Biche Agricultural Society; Village of Hines Creek.

- ***Community Investment: $2,101,000***
- ***Per passenger tire equivalent recycled costs: $0.51***

5.6.2.10 Civic Pride / Community Image

While it is difficult to measure the impact of the tire stewardship program on community image, surveys indicate that the tire program has both a high degree of public awareness and public acceptance. Public awareness of tire recycling in the province is up 3% from 78% in 2003 to 81% 2004. Public acceptance over the same period remained flat, down 1% from 68% in 2003 to 67% in 2004. Public acceptance and support for the program is also a potential measure of the social capital generated by the program; where social capital is defined by the level of trust citizens have that a government program or policy is contributing to the improved well-being of a society.

5.6.2.11 Environmental Stewardship

The more tangible natural capital benefits of tire recycling are captured in such categories as avoided raw material use and reduced environmental liability. While more difficult to measure, the tire recycling stewardship program provides an indirect benefit by helping to foster an environmental consciousness or ethic based on the principles of resource conservation and environmental protection.

6 Used Oil Materials

6.1 Review of Costs and Benefits

In 2004, Alberta's stewardship program for used oil, filters and containers came with a financial price tag of $14.2 million collected through an environmental handling charge (EHC) paid at the first point of sale.

Beyond the more readily apparent program costs and the tangible result of collecting over 72.6 million litres of used oil, 6.7 million kilograms of used oil filters and 1.4 million kilograms of plastic oil containers, there are several other costs and benefits associated with the used oil stewardship program in the province. A review of the used oil stewardship program for the 2004 year highlights many non-traditional environmental and social costs and benefits associated with recovering and recycling used oil and associated products.

Alberta suppliers (the first point of sale), who are typically wholesalers and retailers, are required to remit an environmental handling charge (EHC) for oil, oil filters, and oil containers sold into the province. The EHC fees are 5 cents per litre of oil, 5 cents per litre of oil container size, 50 cents per filter that is less than 8 inches in length and 1 dollar per filter 8 inches or larger in length. Suppliers remit the EHC fees to the Alberta Used Oil Management Association (AUOMA) who uses the money to administer the recycling of used oil, oil filters, and plastic oil containers in the province.

Cost – 1: Administration costs incurred by first sellers (collecting EHC, book-keeping work, remitting fee).

AUOMA provides a financial incentive to collectors and transporters to pick up used oil, oil filters, and oil containers from generators and depots (e.g., service stations / lube centers). The return incentive (RI) varies by region based on transportation costs and historical recovery rates for that region. The RI rate ranges from 8 cents per litre to 17 cents per litre for used oil, $1.09 to $1.50 per kilogram of plastic containers, and 68 cents to $1.19 per kilogram of used oil filters.

Cost – 2: GHG emissions attributed to the transportation from pick up points to processors.

Cost – 3: Return incentive paid for collection and transportation.

Benefit – 1: Direct employment (collection, transportation and processing).

Generators (e.g., oil change operations) and select return depots take materials from those who change their oil directly. Generators and depots temporarily store and facilitate the pick-up of used oil, used oil filters, and empty oil containers. Collectors compensate these parties for storing used oil and associated materials. The return incentive concept therefore is designed to provide an incentive to both collectors and generators / depots to promote the recovery of used oil and associated materials for reuse and recycling. It is important to note, however, that the program operates in a free market system. That is, while the incentive rate paid by AUOMA to collectors is fixed, the actual amount paid to generators / depots for used oil materials fluctuates based on market conditions. For example the value of used oil fluctuates based on crude oil prices.

Cost – 4: Generators / depots are required to store and acknowledge the pick-up of used oil and associated materials.

Benefit – 2: Compensation paid to generators by collectors.

Benefit – 3: Increased competition in collection and transportation markets.

Used oil is used primarily as heating oil for large industrial plant heating and asphalt plant heating. A substantial amount is also reprocessed back into other petroleum products or re-refined into lubricating base oil. AUOMA does not provide any financial incentives for used oil that is used for road oiling. The steel from used oil filters is processed back into new steel and the used plastic oil containers are reprocessed back into plastic products.

Cost – 5: GHG emissions associated with final disposition of recovered oil.

Cost – 6: GHG emissions associated with processing and manufacturing products from recycled plastics and steel.

Cost – 7: Other environmental impacts associated with processing and manufacturing, including air pollution, water pollution, and soil contamination.

Cost – 8: Loss of employment (potential loss of employment at landfills and within municipal collection systems because of reduced volume of material going to landfills).

Cost – 9: Increased cost to find substitutes for using oil as dust suppressant on roads.

Benefit – 4: Increase in employment (processing and manufacturing facilities due to increased volume of materials being diverted).

Benefit – 5: GHG reductions resulting from diversion from the waste stream of used oil, oil filters, and oil containers.

Benefit – 6: Extended landfill life by not disposing of oil filters and oil containers in landfill including savings by delaying costs associated with siting a new landfill.

Benefit – 7: Energy savings by recovering used oil.

Benefit – 8: **Avoided raw material use of products being replaced by recycled oil, steel and plastics.**

Benefit – 9: **Reduced environmental and human health liability by responsibly preventing oil and associated products from entering the environment.**

Benefit – 10: **Reduced municipal waste collection costs by diverting material from regular waste stream.**

The oil stewardship program in the province is overseen by the Alberta Used Oil Management Authority (AUOMA). In addition to facilitating and overseeing the proper handling of used oil and associated materials by administrating funds generated by the EHC, AUOMA also aims to increase the awareness of Albertans regarding the improper disposal of used oil materials (AUOMA, 2005). AUOMA does not have any direct employees of its own; management and administrative responsibilities are contracted out.

Cost – 10: **Government oversight costs incurred by supporting AUOMA programming.**

Cost – 11: **Decreased expenditure in other economic sectors due to investment in oil stewardship program.**

Benefit – 11: **Increase in employment (contracted services).**

Benefit – 12: **Increase in civic pride associated with being a leader in used oil stewardship.**

Benefit – 13: **Investment in environmental stewardship including resource conservation and environmental protection benefits.**

6.2 Context of Analysis

This analysis captures the costs and benefits outlined above for the 2004 year. While there are risks in taking a static perspective, we are confident that this is not an abnormal operating year given the maturity of the program and the consistency in revenues, expenditures, and return rates with previous years. We present results from three different perspectives.

1) 2004 – full cost/benefit assessment of current year
2) Comparison of net marginal costs and benefits between 2004 and the pre-program period
3) Comparison of net marginal benefits (costs) between having a program (2004) versus not having a program in 2004. In this case we assume that the conditions previous to the program would have continued. As such, we assume that recovery rates for oil, oil filters, and oil containers would have remained consistent, however, we factor in increases in consumption patterns. We derived these numbers by multiplying the 1997 recovery rate by the material available for collection in 2004. It is important to note that the assumption of steady recovery rates is likely conservative in the case of used oil, as demand very likely would have driven recovery rates higher, even in the absence of a formal program.

Table 60: Estimated Results for 2004 Assuming Pre-Program Recovery Rates

	Recovery rate (1997)	Available for collection (2004)	Estimated quantity collected for 2004
Used oil (millions of litres)	56%	94.3	52.8
Oil filters (millions of kg)	17%	7.7	1.3
Oil containers (millions of kg)	7%	2.67	0.19

Sources: AUOMA, 2005a; Corporate Link, 2002.

Another key assumption is that generators paid 10.4 cents per litre to have used oil collected previous to the program (StrateThink, 1997). The pre-program cost to have a drum of used oil filters collected is estimated to be $76.8 per drum or $0.69 per kilogram. We assume that these costs were passed on to customers and that they would have remained constant over the years. The rationale behind the constant-fee assumption is that the 5 cent EHC fee has remained unchanged since the introduction of the program. As the disposal of oil containers were not regulated prior to the program, we assume that there were no pre-program disposal costs borne by generators for these materials.

We acknowledge that we applied crude assumptions to determine the 'no program' cost-benefit values for 2004. As such, making comparisons and referencing the 'no program' values should be done cautiously. The inclusion of this option is meant largely as a starting point for discussion and dialogue regarding the merits of having a formal used oil stewardship program as opposed to not having a program.

6.2.1 Comparing Alternate Scenarios

We recognize that it is very complex to determine diversion rates of alternate scenarios. For example, even when comparing to pre-program diversion estimates, we do not know the final disposition of materials prior to the introduction of the program. The conditions influencing final disposition affects cost benefit categories, such as potential GHG impacts or energy savings. Furthermore it is difficult to factor in the influence of advances in technology such as developments in automotive and lubricant technology.

The information required to model alternate scenarios is not readily apparent making modeling complex and problematic. It is especially difficult when trying to assess what a no-program scenario would look like in 2004. For example: is it realistic to assume that pre-program conditions would have continued? There are many factors which are indeterminate. For example, how do increases in oil prices influence the collection of used oil? Would public participation have increased independent of a stewardship program? How do we account for the fact that jurisdictions such as Ontario claim to have used oil return rates similar to Alberta without a formal program?

6.2.2 Cost and Benefit Categories

While this analysis attempts to attribute a monetary value to all categories, in several cases we can only describe the cost or benefit due to the lack of data or the inherent difficulty in monetizing societal and environmental benefits. For a more detailed description of costs and benefits including how dollar values were estimated see Section 6.6.

Table 61 lists the costs and benefits and the associated evaluation methods of categories included in this review of the used oil stewardship program. For a list of all categories considered see Section 3.1 and Table 3.

Table 61: Summary of Costs and Benefits of Oil Stewardship Program

	Evaluation Method	
Costs	**Monetary**	**Description**
Program operating costs		
Recycling incentives (RI)	✓	✓
Program delivery	✓	✓
Administration incl. Amortization	✓	✓
Government costs		
Government support	✓	✓
Supplier/operator costs		
Wholesaler/retailer program support	✓	✓
Operator program support	✓	✓
Environmental costs		
GHG emissions	✓	✓
Other environmental impacts	—	✓
Disruption in marketplace	—	✓
Benefits		
Resource recovery benefits		
Reduction in GHG emissions	✓	✓
Avoided raw material use	✓	✓
Energy savings	✓	✓
Extended landfill life incl. delayed landfill life siting costs	✓	✓
Reduced environmental and human health liability	✓	✓
Employment		
Direct employment	✓	✓
Indirect employment	✓	✓
Community benefits		
Civic pride	—	✓
Environmental stewardship		
Resource conservation and environmental protection	—	✓

6.3 Costs and Benefits Valuation

Where feasible we attempted to attach a monetary value to the costs and benefits explored in this analysis of the used oil stewardship program. A low, medium and high range is estimated for each category. The spread in range of estimates highlights the inherent challenges in valuation exercises.

Several cost and benefit categories included in the Genuine Wealth analysis were not monetized in our review of the used oil stewardship program This was either due to a lack of data to confidently assign a value or simply an acknowledgement that some non-traditional costs and benefits cannot adequately be valued in any meaningful way.

Categories not monetized include:

- Disruption in the marketplace
- Reduced environmental and human health liability
- Civic pride
- Resource conservation / environmental protection

As the relative magnitude of these costs or benefits is unknown, their overall impact on the outcome is hard to speculate. Additional research may serve to increase the understanding of the contributions these factors have to the overall program value.

We assessed the direct costs and benefits of the program in 2004, the net marginal costs and benefits of the program in 2004 vs. 1997 (pre-program), and the net marginal costs and benefits of having a program in 2004 versus not having a program in 2004 assuming pre-program recovery rates.

A summary of the monetized costs and benefits of the used oil stewardship program indicate that the program in 2004 offered a net marginal benefit of between $17.7 million and $21.7 million. This is based on an estimated program cost of $14.3 million. The estimated program benefits range from $32 to $36 million.

The estimated benefit generated by the used oil stewardship program per Albertan ranges from $5.43 per Albertan to $6.67 per Albertan.

The net marginal benefit of the used oil stewardship program in 2004 ($17,670,618) in comparison to the pre-program year (1997) ($2,483,600) is $15.2 million. This suggests that the program has resulted in increased benefits to Albertans.

The net marginal benefit of the oil stewardship program in 2004 ($17,670,618) as opposed to not having a program in 2004 assuming a continuation of pre-program recovery rates ($15,210,700) is $2.5 million. In this scenario we are multiplying 2004 volume numbers by 1997 recovery rates. Table 62 provides a summary of the monetized costs and benefits of the used oil recycling program.

Table 62: Summary of Monetized Costs and Benefits

USED OIL STEWARDSHIP PROGRAM COSTS AND BENEFITS (2004)			
Program Operating Revenues			
Revenues from EHC	$14,192,316		
Other revenues (interest, investment income, other)	$252,594		
Total Revenues	**$14,444,910**		
		Pre-program 1997 (Low)	**No program 2004 est. (Low)***
Program Operating Costs			
Program operating costs	$14,166,283	$0	$0
Other Non-Program Societal Costs			
Municipal waste disposal costs	$96,200	$281,100	$329,300
Supplier/ operator program support	$0	$4,850,000	$6,387,000
Government support	$64,499	$0	$0
Disruption in marketplace	$0	$0	$0
Total Program Costs	**$14,326,982**	**$5,131,100**	**$6,716,200**
Material Recycled (2004)			
Used oil (litres)	72,500,000	40,000,000	53,000,000
Used oil filters (kg)	6,400,000	1,000,000	1,300,000
Plastic oil containers (kg)	1,300,000	200,000	200,000

	Low	Medium	High	Pre-program 1997 (Low)	No program 2004 (Low)*
Societal Benefits					
Reduction in GHG emissions	$591,000	$1,821,000	$3,051,000	$288,000	$195,000
Extended landfill life	$1,560,000	$1,950,000	$2,379,000	$260,000	$304,000
Avoided siting and operational costs	$4,600	$11,000	$18,000	$700	$900
Avoided raw material use	$144,000	$144,000	$144,000	$27,000	$29,000
Energy savings**	$29,381,000	$29,381,000	$29,381,000	$7,039,000	$21,398,000
Direct employment	$153,000	$240,000	$523,000	$0	$0
Indirect employment	$164,000	$256,000	$558,000	$0	$0
Community investment	$0	$0	$0	$0	$0
Total Societal Benefits	**$31,997,600**	**$33,803,000**	**$36,054,000**	**$7,614,700**	**$21,926,900**
Net Annual Costs/ Benefits	**$17,670,618**	**$19,476,018**	**$21,727,018**	**$2,483,600**	**$15,210,700**
Net Annual Costs/Benefits per Albertan* **	**$5.43**	**$5.98**	**$6.67**	**$0.76**	**$4.67**

Net marginal benefits (costs) program (2004) vs. pre-program (low estimate): $15,187,018

Net marginal benefits (costs) program (2004) vs. no program (low estimate): $2,459,918

*Assumes a continuation of the pre-program recovery rate.

** See the section on energy savings to understand how estimates were calculated.

***Assumes a population of 3,256,800. Although this is an average per-capita cost, it is important to note that this is a user-pay program, and as such, the amount paid by individuals varies based on their purchase of oil, filters and containers.

Sources: This summary table synthesizes data from several tables. Please refer to tables in the costs and benefits description section for sources.

6.4 Monetary and Physical Description of Cost and Benefit Categories

In addition to attributing a monetary value to cost and benefit categories, this analysis also provides a physical description for each category. Table 63 highlights these results and includes a column identifying who bears the costs and who receives the benefits being described.

Please note that Table 63 is not a cost/benefit summary table. Row results are not commensurable and should not be added up. Monetary estimates and monetary estimates per container speak only to the line item which they reference. A detailed description of each of these line items is provided in Section 6.5. Table 62 (above) provides a summary of the costs and benefits.

Table 63: Cost-Benefit Analysis – (2004) (Monetary and Physical)

	2004 costs	
Genuine Wealth Analysis	**Monetary**	**Physical**
Revenue	***$14,444,910***	
– Environmental handling charge	***$14,192,316*** ***- oil: $7,273,918*** ***- filters: $4,442,843*** ***- containers: $2,458,611***	***98.3% of total revenue*** ***- $0.05 paid per litre of oil*** ***- $0.50 - $1.00 per filter*** ***- $0.05 paid per litre size***
– Registration fees	***$3,813***	***< 0.1% of total revenue***
– Investment income	***$248,781***	***1.7% of total revenue***
Costs		
Program operating costs		
Return incentives (Paid to collectors and transporters)	$13,205,154 – Used oil: $6,854,348 – Filters: $4,336,240 – Containers: $2,014,400	93.2% ot total expenditures 72,641,118 litres collected 6,681,872 filters collected 1,350,097 kg collected
Program delivery	$486,521	3.4% of total expenditures
Administration incl. Amortization	$474,737	3.4% of total expenditures
Operating cost subtotal	**$14,166,432** – Used oil: $7,463,237 (15%) – Filters: $4,721,415 (33%) – Containers: $2,193,334 (15%)	$0.10 per litre of oil collected $0.71 per filter collected $1.62 per container collected
Municipal waste disposal costs	**$96,200**	6,391 tonnes of oil filters 2,463 tonnes of oil containers
Government support costs	**$64,499**	Ongoing support days - 24/year
Supplier program support	Negligible	collect and remit levy
Retailer program support	$0 (compensated)	Compensated by collectors to collect and store materials. Potential benefit opportunity.

Collectors / transporters	Receive RI and sell materials to processors	Oil: \$0.08-\$0.17/litre; \$0.87-\$1.10/kg oil filters; \$0.68-\$1.19/kg plastic containers
GHG emissions - transportation	Incl. in overall GHG estimate	
Processing and Recycling Costs		
GHG emissions - processing and recycling	Incl. in overall GHG estimate	Used oil GHG impact depends largely on final disposition
Other environmental impacts - incl. air pollution and water use		
Disruption in marketplace		
Increased competition	\$0	Potential overall economic benefits as a result of increased competition. This may have negative impacts on players in business pre-program.
Benefits		
Reduced costs resulting from resource recovery		
Reduction in GHG emissions	range: \$591,000 – \$3,051,000 (\$27/tonne - \$142/tonne) Assumes low MTCE estimate Used oil: \$437,000 – \$8,691,000 Oil filters: \$70,000 – \$362,000 Oil containers: \$84,000 – \$433,000	21,540 MTCE – 66,960 MTCE
Extended landfill life	range: 1.6 million – \$2.4 million (low - \$40/m^3 ; high - \$61/m^3)	39,000 yd^3
– Avoided siting and operational costs	range: \$4,620 - \$18,249 (\$0.60/tonne – \$2.37/tonne) Values are included in extended landfill life benefit.	
Avoided raw material use	\$144,300 Recycled steel feedstock \$44,000; Recycled HDPE feedstock = \$100,300	Oil filters: 2,200 tonnes of steel feedstock; 1,300 tonnes of HDPE feedstock
Energy savings	\$29,381,220; Oil price: \$68.97/barrel (2005 avg. price)	72,500,000 litres of used oil
Reduced environmental and human health liability		Includes water, air, and soil

Employment / Economic		
Direct employment	range: $153,000 – $523,000 (range depends on # of jobs which are new vs. transfer)	Jobs supported – 98
Indirect employment	range $164,000 – $558,000 (range depends on # of jobs which are new vs. transfer)	Jobs supported 127
Community benefits		
Community investment	0$	AUOMA does not directly fund community projects.
Civic pride		63% of Albertans are aware of oil stewardship program.
Environmental stewardship		
Resource conservation and environmental protection		

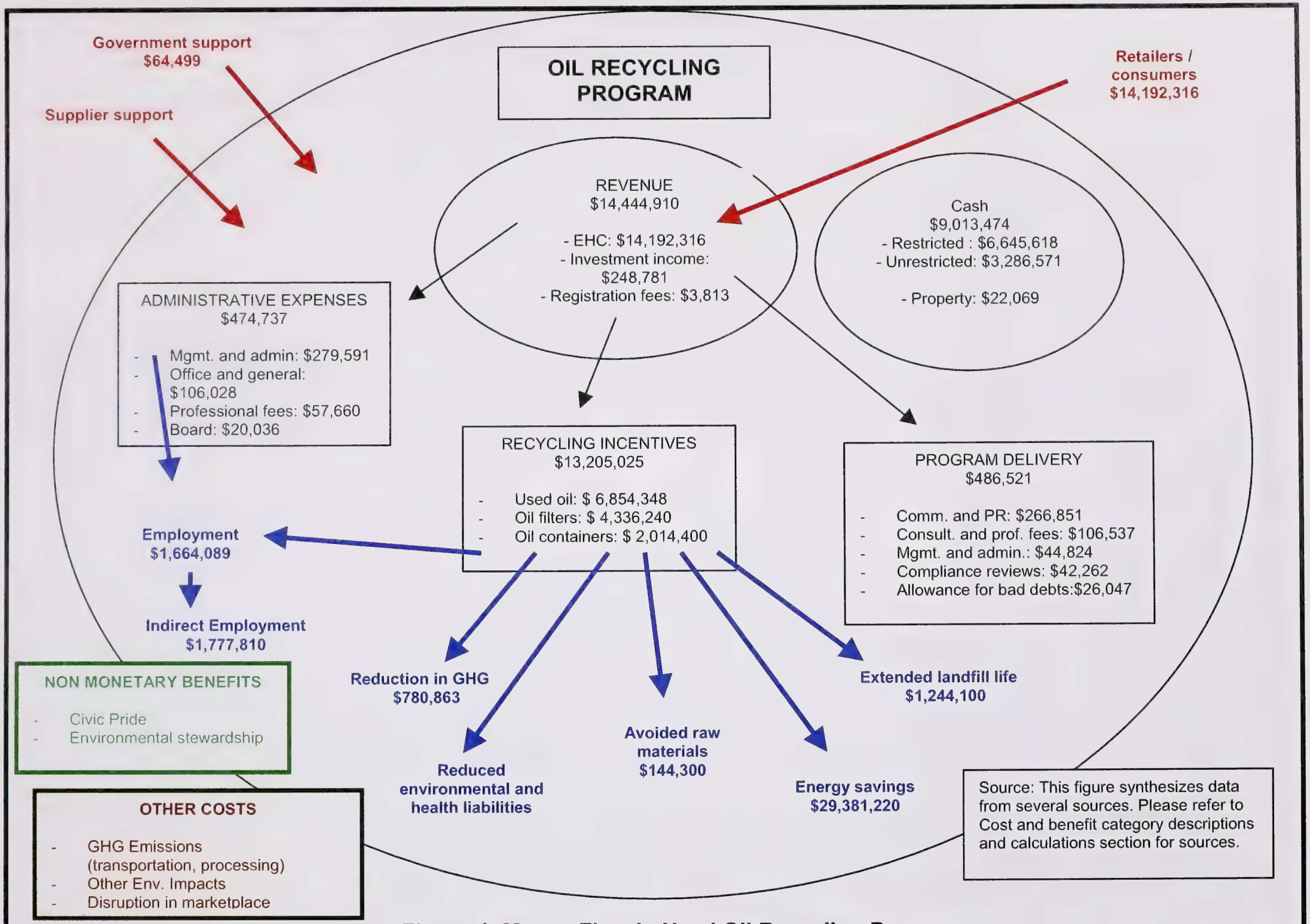
Sources: This summary table synthesizes data from several tables. Please refer to tables in the costs and benefits description section for sources.

6.5 Cost Benefit Flow of Oil Stewardship Program (2004)

6.5.1 Monetary Flow Analysis (2004)

The return incentive model drives the used oil stewardship program. The AUOMA pays a return incentive to collectors, which in turn allows them to compensate operators (return depots and generators) for storing used oil and associated materials. The program therefore is designed to provide an incentive to both collectors and operators to promote the recovery of used oil and associated materials for reuse and recycling.

Of the $14.4 million in revenue collected by the AUOMA in 2004 operating year, 93% was paid out directly in return incentives. To facilitate this process administration and program delivery costs were approximately $960,000. AUOMA does not directly fund research, technology and innovation, capital investment, community projects, or clean up activities (AUOMA, 2005a).



Source: This figure synthesizes data from several sources. Please refer to Cost and benefit category descriptions and calculations section for sources.

Figure 4: Money Flow in Used Oil Recycling Program

6.6 Cost and Benefit Category Descriptions and Calculations

This section reviews each item included in the cost and benefit analysis providing a description of each category. If a monetized value was estimated for the category, an explanation of how the monetized value was estimated is provided.

6.6.1 Costs of Used Oil Management Program

6.6.1.1 Program Operating Costs

The Alberta Used Oil Management Association (AUOMA) is responsible for managing Alberta's used oil program.

AUOMA's mission is to develop and manage programs that encourage responsible environmental handling and recycling of used oil materials (used oil, oil filters and oil containers) in all markets in Alberta.

Materials that currently fall under AUOMA's mandate include:

- Any petroleum or synthetic crankcase oil, engine oil, hydraulic fluid, transmission fluid, gear oil, heat transfer fluid or other fluid used for lubricating purposes in machinery or equipment.
- Any spin-on or element oil filter used in hydraulic, transmission or internal combustion engine applications - includes diesel fuel filters but does not include gasoline fuel filters.
- Any plastic container with a capacity of less than 30 litres that is manufactured to hold oil.

AUOMA is statutorily enabled under the Lubricating Oil Material Recycling and Management Regulation to collect an environmental handling charge on the sale of materials within AUOMA's mandate. AUOMA is authorized to dispense these funds to oversee the recycling of used oil and associated materials in the province (AUOMA, 2005).

6.6.1.1.1 AUOMA Revenue and Reserve

In 2004, AUOMA collected over $14.4 million in revenues to support used oil recycling throughout the province. The collection of EHC fees generated over 98% of this revenue. In addition, AUOMA has a net reserve of $8.1 million dollars; $6.6 million of this amount is internally restricted. The restricted portion of the reserve fund has been set aside to cover six months of operation when the program is winding down and to provide financial security in the event of unforeseen claims or liabilities. Table 64 reviews program funds.

Table 64: Program Funds (2004/2005)

Revenue		
EHC	$14,192,316	98.3%
Investment income	$248,781	1.7%
Registration fees	$3,813	Less than 0.1%
Total revenue	**$14,444,910**	**100.0%**
Reserve		
Restricted	$6,645,618	81.9%
Unrestricted	$1,465,046[20]	19.1%
Total reserve	**$8,110,664**	**100.0%**

Source: AUOMA, 2005a.

6.6.1.1.2 AUOMA Expenditures

Expenditures to operate the program totaled $14.2 million in 2004. As indicated in Table 65, recycling incentives to support collectors, transporters and processors totaled $13.2 million or 93.2% of total expenditures. $487,000 went towards program delivery or 3.4% of total expenditures. Administration costs totaled $475,000 or 3.4% of total expenditures.

Table 65: Program Expenditures (2004/2005)

Category	Expenditure	Percent of total expenditure
Return incentives	$13,205,025	93.2%
Program delivery	$486,521	3.4%
Administration	$474,737	3.4%
Total expenditures	**$14,166,432**	**100.00%**

Source: AUOMA, 2005a.

In sum,

- ***Program operating costs: $14,166,432***

6.6.1.1.2.1 Return Incentives

Return incentives paid to collectors, transporters and processors represent the single largest expenditure by AUOMA. Return incentives paid on used oil, oil filters, and oil containers were $6.85 million, $4.34 million, $2.01 million respectively.

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[20] Unrestricted revenues can fluctuate greatly over the calendar period.

Table 66: Return Incentives by Material

Return incentives	Quantity recovered	Return incentives paid	Average paid per unit
Used oil	72.6 million litres	$6,854,384	$0.09/litre
Oil filters	6.7 million filters	$4,336,240	$0.65/filter
Oil containers	1.34 million kilograms	$2,014,401	$1.49/kg
Total return incentives		**$13,205,154**	

Source: AUOMA, 2005a.

This return incentive model is intended to drive the used oil stewardship program. Previously, generators paid collectors to remove used oil for processing. In spite of there being an existing infrastructure for collecting and processing used oil before the program, only half of the used oil being generated was getting recovered. In addition, before the program generators were responsible for disposing of used oil filters and oil containers. The recycling recovery rate of these materials was very low.

AUOMA pays a return incentive to collectors and transporters, which in turn allows them to compensate operators (return depots and generators) for storing used oil and associated materials. The program therefore is designed to provide an incentive to both collectors and operators to promote the recovery of used oil and associated materials for reuse and recycling. It is important to note, however, that the program operates in a free market system. While the incentive rate paid by AUOMA is fixed, the actual amount paid and received by collectors for used oil materials fluctuates based on market conditions such as crude oil prices or the current price for recycled HDPE feedstock.

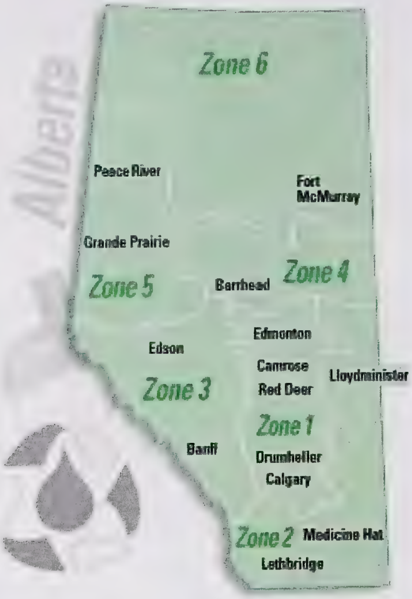
The return incentive rate paid to collectors varies by product and region. The variable rates are designed to compensate collectors for differences in regional collection and transportation costs. See Table 67 for a breakdown of incentive rate by product and by region.

Table 67: Return Incentive Rate by Product and Zone (Collectors and Transporters)

Zone	Used Oil ($/litre)	Used Oil Containers ($/kg)	Used Oil Filters ($/kg)
1	0.08	1.09	0.68
2	0.10	1.35	0.76
3	0.10	1.31	0.76
4	0.10	1.20	0.85
5	0.12	1.31	0.94
6	0.17	1.50	1.19

Source: AUOMA, 2006.

Figure 5 provides a schematic of the incentive zones in Alberta.



Source: AUOMA, 2006.

Figure 5: Return Incentive Zone Map

There is also a return incentive paid to processors of plastic oil containers. The incentive rate is $0.30 per kilogram recycled.

6.6.1.1.2.2 Program Delivery

In 2004, AUOMA spent over $485,000 on program delivery. This included $267,000 on communication and public relations and over $100,000 in consulting and professional fees. Table 68 provides a more detailed breakdown of program delivery expenditures.

Table 68: Recycling Development and Promotion Expenditures

Program delivery costs by category	Expenditure	Percent of total program delivery expenditures
Communication and public relations	$266,851	54.8%
Consulting and professional fees	$106,537	21.9%
Mgmt. and admin. contracts	$44,824	9.2%
Compliance reviews	$42,262	8.7%
Allowance for bad debts	$26,047	5.4%
Total program delivery expenditure	$486,521	100.0%

Source: AUOMA, 2005a.

6.6.1.1.2.3 Administration

Administration costs represent 3.4% of AUOMA's total expenditures or $474,737. As indicated in Table 51, almost 60% of this amount went towards management and administration contracts.

Table 69: Administration Expenditures

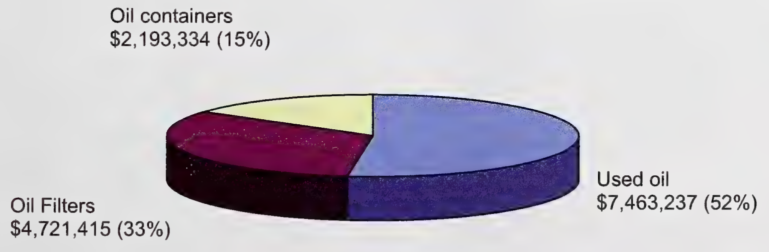
Administration costs by category	Expenditure	Percent of total administration expenditures
Management and administration contracts	$279,591	58.9%
Office and general expenses	$72,763	15.3%
Professional fees	$57,660	12.1%
Rent	$33,265	7.0%
Board expenses	$20,036	4.2%
Amortization	$11,422	2.4%
Total administration expenditure	$474,737	100.0%

Source: AUOMA, 2005a.

6.6.1.2 Summary of Program Operating Costs

The total program operating costs in 2004 were $14.17 million dollars. Table 70–Table 72 provide a summary of program operating costs by material. For comparison purposes the tables provide a historical perspective since the inception of the oil stewardship program in 1998. The tables include a total cost by material, and an estimated cost by unit of material. Figure 6 highlights the total program costs by material type for 2004.

Figure 6: Total Program Operating Costs by Collected Material (2004)



Sources: Corporate Link, 2002; AUOMA, 2005a. Corporate Link extended for 2003, 2004 using AUOMA 2004 annual report numbers.

Used oil is unique in that the amount sold is not all collectable as approximately 35% is lost during consumption. As such, Table 70 includes a column entitled collectable (litres). This refers to the amount that is potentially available for collection. The total program operating cost in 2004 for the used oil portion of the program including the share of program administration and delivery costs is $7.46 million.[21] This equals a cost per litre of used oil collected of 10 cents per litre. The cost per litre collected has remained relatively constant since 1998 hovering around 10 cents per litre.

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[21] The 2004 estimate was derived by extending the annual data reported by Corporate Link (2002) using the AUOMA (2005) 2004 annual report numbers.

Table 70: Program Operating Costs (Used Oil)

	Sales (Litres)	EHC ($)	Collectable (Litres)	Collected (Litres)	RI ($) (includes UOH)	program administration and delivery costs	Total costs ($)	Cost per litre collected ($)
1998	128,601,835	$6,430,091	82,948,182	54,329,490	$5,065,749	$482,615	$5,548,364	$0.10
1999	132,402,174	$6,620,108	85,399,403	57,698,490	$5,369,927	$462,275	$5,832,202	$0.10
2000	138,906,850	$6,945,343	89,594,918	59,909,276	$5,616,389	$624,808	$6,241,197	$0.10
2001	143,331,859	$7,166,592	92,449,047	65,411,426	$6,168,094	$774,966	$6,943,060	$0.11
2002	123,279,725	$6,163,987	79,515,422	67,322,146	$6,340,058	$767,940	$7,107,998	$0.11
2003	140,681,300	$7,034,065	90,739,438	67,749,171	$6,396,588	$683,643	$7,080,231	$0.10
2004	145,478,359	$7,273,918	93,833,541	72,641,118	$6,854,384	$608,853	$7,463,237	$0.10

Sources: Corporate Link, 2002; AUOMA, 2005a.

Table 71: Program Operating Costs (Oil Filters)

	Sales (# filters)	EHC ($)	Collected (# filters)	RI ($)	administration and delivery costs	Total costs ($)	Cost per filter collected ($)
1998	6,295,899	$3,566,414	4,076,640	$3,363,335	$320,426	$3,683,761	$0.90
1999	6,342,562	$3,599,505	4,785,869	$3,972,450	$341,972	$4,314,422	$0.90
2000	6,719,313	$3,859,885	5,420,566	$4,544,287	$505,539	$5,049,826	$0.93
2001	6,926,183	$3,979,448	5,804,131	$4,200,513	$527,757	$4,728,270	$0.81
2002	6,722,044	$3,849,989	5,925,230	$3,839,196	$465,023	$4,304,219	$0.73
2003	7,129,641	$4,156,161	6,055,141	$3,944,245	$421,546	$4,365,791	$0.72
2004	7,700,869	$4,442,843	6,681,872	$4,336,240	$385,175	$4,721,415	$0.71

Sources: Corporate Link, 2002; AUOMA, 2005a.

The total program operating cost in 2004 for the oil filter portion of the program, including the share of program administration and delivery cost, is $4.72 million. This equals a per-filter collected cost of $0.71 cents per filter. The per-filter unit cost has decreased by over 20% since 1998.

Table 72: Program Operating Costs (Oil Containers)

	Sales (kg)	EHC ($)	Collected (kg)	RI ($) (includes processing)	Program administration and delivery costs	Total costs ($)	Cost per kg of containers collected ($)
1998	2,738,971	$2,568,366	553,525	$580,836	$55,336	$636,172	$1.15
1999	2,617,322	$2,464,003	820,220	$922,269	$79,394	$1,001,663	$1.22
2000	2,596,865	$2,445,087	947,889	$1,119,950	$124,591	$1,244,541	$1.31
2001	2,576,807	$2,427,039	1,081,651	$1,271,644	$159,771	$1,431,415	$1.32
2002	2,517,709	$2,357,913	1,200,527	$1,422,718	$172,327	$1,595,045	$1.33
2003	2,550,779	$2,372,564	1,260,483	$1,520,217	$162,475	$1,682,692	$1.33
2004	2,681,739	$2,458,611	1,350,097	$2,014,401	$178,933	$2,193,334	$1.62

Sources: Corporate Link, 2002; AUOMA, 2005a.

The total program operating cost in 2004 for the plastic oil container portion of the program including the share of program administration and delivery costs is $2.19 million. This equals a per kg of oil containers collected cost of $1.62 per kg. Between 1998 and 2004, the operating cost per kilogram recovered has increased by 40% per kilogram.

6.6.1.3 Environmental Handling Charge

The program is funded by an environmental handling charge (EHC) paid on the sale of lubricating oils, oil filters, and oil containers. The EHC is paid at the first point of sale (typically the wholesale level) and remitted to AUOMA to oversee the used oil stewardship program.

Table 73: Environmental Handling Charges

Oil	Oil container		Filter (more than 8")
5 cents/ litre	5 cents per litre size	50 cents	1 dollar

Source: AUOMA, 2006.

The EHC rates are fixed throughout Alberta and have remained stable over the life of the program.

In 2004, AUOMA collected $14,192,316 in EHC fees.

- Used oil: $7,273,918 EHC collected
- Oil containers: $4,442,843 EHC collected
- Oil filters: $2,458,611 EHC collected

While the EHC is theoretically a new fee as it was introduced as part of the oil stewardship program, retailers before the program were paying to have used oil and oil filters removed. Oil containers were predominantly disposed of in the regular waste stream.

Previous to the program, the cost of recycling used oil and oil filters was incurred by retailers/generators who paid approximately 10.4 cents per litre to have used oil collected and 69 cents per kg to have used oil filters collected (StrateThink, 1997). While retailers incurred these costs, they were passed on to consumers through an environmental handling fee or included in the price.

In the year previous to the introduction of the program, it is estimated that 56% of used oil was recovered, or 40 million litres, and 17% of used oil filters were recovered or 1 million kilograms. At pre-program collection rates of 10.4 cents per litre of used oil and 69 cents per kilogram of used oil filters, retailers **paid $4,160,000 to have used oil collected and $690,000 to have used oil filters collected totaling $4.85 million in collection costs.** It is important to note that this cost only reflects those generators handling the material in a responsible manner. The significant portion of oil and filters not being properly collected and managed still would have represented a cost to the generator to dispose of improperly. Therefore, this pre-program cost is undoubtedly significantly understated. However, without quantified baseline information, the exact magnitude is not understood.

If we assume that the pre-program rate of recovery would have remained constant without a formal program, 52.75 million litres of oil would have been recovered in 2004 and 1.3 million kilograms of used filters

52.75 million litres of oil recovered X 10.4 cents per litre = **$5.49 million.**

1.3 million kilograms of used filters X 69 cents per kilogram = **$897,000.**

- ***Environmental handling charge (2004): $14,192,316***
- ***Net marginal increase in disposal charge 2004 vs. pre-program: $9.20 million***
- ***Net marginal increase in disposal charge for current program vs. no program: $7.61 million***

It is important to recognize that the per unit recovery cost of used oil and used oil filters has remained relatively constant when comparing the pre-program costs to the costs of the program in 2004. The additional money generated through the EHC as opposed to those costs borne directly by retailers previous to the program is due to the dramatic increase in recovery rates and by introducing the recovery of used oil containers which were disposed of in the regular waste stream prior to the program.

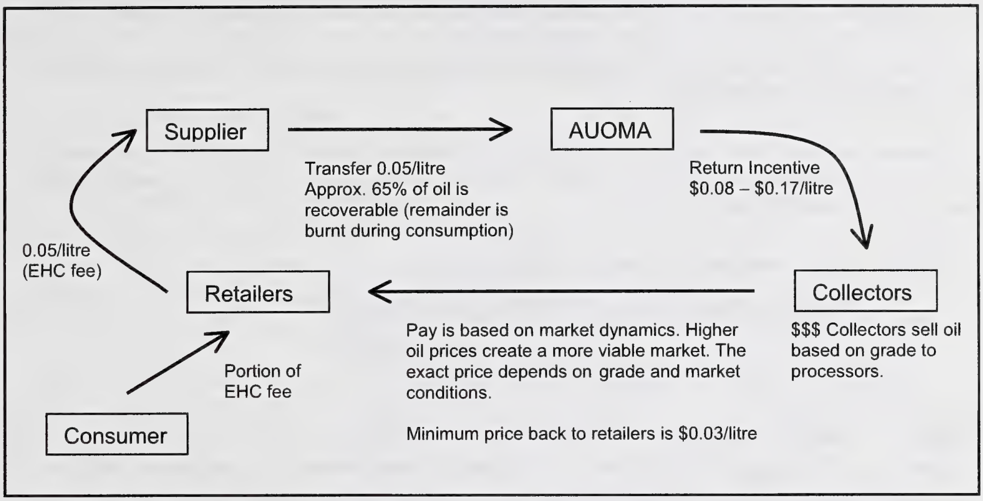
Who bears the cost of the EHC is not readily apparent. While wholesalers (first point of sale) are responsible for collecting the EHC, they pass it on to retailers either as an environmental handling charge (which is listed on the bill of sale) or embedded directly into the sale price.

The retailer, however, is compensated for collecting and storing used oil materials by collectors who pay them market value for the materials. Collectors receive the return incentive (RI) from AUOMA, which creates a minimum market value offsetting a portion of EHC costs borne by retailers.

An outstanding issue, however, is if a portion of the EHC is passed on to consumers by retailers. Retailers do charge an environmental fee to consumers but it includes all environmental handling, storage, and disposal costs of their services. The fee is not broken down by material.

Figure 7 depicts the potential flow of the EHC using used oil as an example.

Figure 7: EHC Flow (Used Oil Example)


Supplier
AUOMA
Transfer 0.05/litre
Approx. 65% of oil is recoverable (remainder is burnt during consumption)
Return Incentive
$0.08 – $0.17/litre
0.05/litre
(EHC fee)
Retailers
Collectors
Pay is based on market dynamics. Higher oil prices create a more viable market. The exact price depends on grade and market conditions.
$$$ Collectors sell oil based on grade to processors.
Portion of EHC fee
Consumer
Minimum price back to retailers is $0.03/litre

Pre-program costs for used oil and filter collection were paid by retailers (estimated at $5.13 million). These costs were passed on to consumers as a disposal charge. As most of the empty plastic containers went into the regular municipal waste stream, the cost of managing these materials was ultimately borne by taxpayers.

6.6.1.4 Municipal Waste Disposal Costs

While there are costs associated with recovering used oil materials, there are also costs associated with the materials not recovered. In the case of used oil, the final destination of material not recovered is unknown. There is a strong likelihood that a good portion of that material ended up in the environment. It is assumed used oil filters and empty containers that were not recovered ended up in the regular waste stream. Table 74 highlights the amount of used oil materials not recovered in 1997 and 2004.

Table 74: Materials Not Recovered

	Used oil (litres)	Oil filters (tonnes)	(tonnes)
Pre-program (1997)	31,000,000	4,900	2,700
2004	22,000,000	1,300	1,300
No program 2004	41,500,000	6,400	2,500

By using an average of landfill tipping fees for Alberta, we can estimate the disposal costs of materials that were disposed of in the regular waste stream. The average landfill tipping fee in 2005 was $37/tonne.

In 2004, the estimated landfill disposal cost of used oil filters and empty oil containers **equaled $96,200.**

Assuming the real costs of landfill disposal were similar in 1997, the costs of oil filters and oil containers entering the regular waste stream **would have cost $281,200.**

The landfill disposal costs of oil filters and oil containers assuming no program in 2004 would have been **$329,300.**

We assume the majority of the unaccounted for used oil likely did not end up in landfills. As such we assume the costs are better captured under environment and health liability costs (addressed in Section 6.6.6).

- ***Municipal waste costs (2004): $96,200***
- ***Municipal waste costs (pre-program): $281,100***
- ***Municipal waste costs (no program): $329,300***

6.6.1.5 Supplier Costs

Under the Lubricating Oil Material Recycling and Management Regulations suppliers (typically wholesalers) are required to collect an EHC on the sales of used oil, oil filters, and oil containers at the first point of sale. Suppliers therefore incur an administration cost by collecting the EHC and remitting it to AUOMA.

While the administrative cost incurred by collecting the EHC and remitting it to AUOMA is a new cost, the burden of this cost is assumed to be negligible. AUOMA (Hambleton, 2006) reports that no company has had to add staff time to deal with remittances or complained about the additional time burden.

- ***Supplier costs: $0***

6.6.1.6 Retailer Costs

As noted in the discussion on the EHC fee, wholesalers pass on the costs of the EHC to retailers. It is assumed that retailers either recoup these costs (and potentially more) through the payment they receive from collectors or pass it on to consumers.

Understanding the nature of retailer costs, however, is difficult because operators are compensated for participating in the program, as a portion of the EHC makes it way back to them. In addition, because there are potential markets for used oil materials, retailers can profit from the sales of used oil materials to collectors, suggesting the system facilitates a business opportunity.

In addition to providing revenue to retailers under the new program, the incentive has encouraged more diligent recovery of used oil. The recovery rate in 2004 was 20% higher than in 1997.

The fact that retailers are now compensated to collect, temporarily store and acknowledge the pick-up of used oil, used oil filters, and empty oil containers may lead to savings in other ways to retailers. One notable example is the reduction of nuisance cost.

Previous to the program, retailers still had to dispose of used oil, used oil filters, and empty oil containers. If the materials were being disposed of responsibly, they would have been required to collect and store these materials as well. Only, previous to the program, retailers were not being compensated for the costs.

- ***Retailer costs: $0***

6.6.1.7 Public / Household Costs

As indicated in the environmental handling fee section, a portion of the environmental handling fee may be borne by the consumer. While theoretically the price that collectors pay to retailers offsets a portion or all of the EHC fee which is passed on to them by wholesalers, it is not clear what portion (if any) of this fee is passed on to the consumer.

Furthermore, as the price that collectors pay retailers for used oil materials depends on market conditions, the percentage of the EHC passed on to consumers may vary. It also depends on material. For example, with the current high oil prices, there is a strong market for used oil. As the environmental handling fee is addressed as a category on its own, we do not attribute what proportion of that value may be borne by consumers.

6.6.1.7.1 Time

From a household perspective, the time cost of participating in the program is negligible as lubricating oils and associated materials (containers and filters) are typically disposed at operating facilities. Those who change their oil directly are required to take the used oil to an environmental handling facility. While there is a time cost associated with this, it is assumed to be marginal. The existing time burden on the household is similar to the process previous to the program. Adding an environmental handling charge at the point of sale does not impose any additional time demands on the household either.

- ***Time costs: $0***

6.6.1.7.2 Transportation

Similar to the reasoning above, there are negligible direct transportation costs borne by the public as a result of the used oil stewardship program.

- **Household transportation costs: $0**

6.6.1.8 Government Support Costs

The Alberta Used Oil Management Association is a delegated administrative organization (DAO), which operates at an arms length from the government for transparency and accountability purposes. The government does, however, help support AUOMA. Alberta Environment assists with program compliance monitoring. In addition, an employee from Alberta Environment has a seat on the AUOMA board. Alberta Environment also provided substantial support to help develop and introduce the program.

Based on estimates provided by Alberta Environment (2005), program development and launch costs totaled $320,000 in staffing time and $80,000 in consulting fees paid by the government. If we distribute this amount over the length of program operation (7 years – 1998-2004), it equals $57,143 per year. This estimate should be discounted over 10 years using an NPV formula using an average interest rate of 4-5% (social discount rate est.).

Ongoing support is estimated at 2 days per month in total staffing time. This includes the combined time allocated by program staff, managers, and the assistant deputy minister. Assuming an $80,000 annual salary and 261 workdays per year this equals ongoing government support costs of $7,356.32.

- ***Government support costs (2004): $64,499***

6.6.1.9 Collection and Transportation Costs

AUOMA paid out almost $13 million in return incentives to ensure that used oil, oil filters, and used containers are diverted from the waste stream. Collectors and transporters are compensated for their direct costs by receiving a return incentive. As noted above in Table 73, the return incentive ranges from 8 cents per litre to 17 cents per litre for used oil, 1.09 dollars to 1.50 dollars per kg of used filters, and 68 cents to 1.19 dollars per kg of plastic oil containers.

It is also important to remember that collectors (if they are not formally working for a processor) sell the materials to processors. The prices they receive depend on market conditions.

6.6.1.9.1 GHG Emissions – Transportation

Again, this report relies on an overall estimate of GHG savings that are achieved by the increased recycling of used oil and associated materials in 2004 versus the pre-program rate. It is important, however, to highlight components of the program that have led to direct increases in GHG emissions. For example, there has been an increase in transportation required to collect and transport used oil materials to processing points. The increase in transportation is a result of a general increase in transportation required to support the increased amount of material being recovered. Also, before the program, minimal amounts of oil filters and used oil containers were collected. While some collectors collect all three materials for delivery to processing points, there are other collectors which are material specific, such as collecting used oil only. There are possible transportation savings by promoting bundled collection of used oil materials.

At the macro level, the overall impact of increased transportation is minimal when considering the overall GHG emission impacts of expanding used oil recovery and oil filter and oil container recycling efforts. According to a 2001 European Commission study examining the life cycle environmental impacts of reusing used oil, the environmental impacts due to collection and transport of used oil and primary materials are insignificant within a life cycle perspective compared to the impacts of the industrial recycling processes.

6.6.1.10 Processing and Recycling Costs

There are relatively strong markets for used oil and steel (used oil filters). In some cases operators are receiving up to 16 cents per litre (2005) for high quality used oil suggesting that there is healthy demand among processors for product (Hambleton, 2005).

AUOMA does pay a return incentive to processors of plastic oil containers of 30 cents per kilogram recycled to compensate for the difficulties in processing oily plastic (Hambleton, 2005).

6.6.1.10.1 GHG Emissions – Recycling Used Oil

There are GHG emissions associated with processing used oil which can vary dramatically depending on final disposition. There are also GHG emissions generated by recycling oil filters and oil containers. While it is important to recognize that substantial GHG emissions are generated processing and recycling used oil and associated materials, this analysis provides an overall program estimate of the greenhouse gas impacts only. See the section on greenhouse gas savings benefit below.

6.6.1.11 Disruption in Marketplace

According to an Environment Canada review of extended producer responsibility and stewardship programs in Canada, the recycling of used oil and associated products in Alberta operates on a level playing field. This is attributed to the fact that the program is mandatory and consistent throughout the province (2002).

Creating a financial incentive for collection, transportation, and processing used oil and associated materials has led to increased competition in the marketplace. While clearly the increased competition may have impacted those already in the market previous to the program, to date none of the registrants have left the program suggesting a healthy marketplace (Corporate Link, 2002). Furthermore, increased competition is considered an impetus for innovation and better service suggesting that any disruption in the marketplace has come at a benefit and not a cost.

Under the program AUOMA does not provide financial incentives for used oil that is used in road oiling dramatically discouraging this option as a used oil end use. Previous to the program using used oil for road oiling was a common practice. The program may have disrupted this market leading to an increase in costs for substitutes. However, at the same time, the reduction of road oiling also provides environmental benefits by reducing the amount of used oil entering the environment.

- ***Disruption in market place costs: 0***

6.6.2 Benefits of Used Oil Management Program

6.6.2.1 Reduction in Greenhouse Gas Emissions Benefit

6.6.2.1.1 Used Oil

Based on the European Commission report (2001) entitled "Critical Review of Existing Studies and Life Cycle Analysis on the Regeneration and Incineration of Waste Oils", the greenhouse gas impacts by used oil end use range from a savings of 1,200 kg CO_2/kg WO for the burning of used oil in a cement kiln to an increase of 50 kg CO_2/kg WO for gasification (see Table 75).

Table 75: GHG Impacts of Used Oil Management Options (kg CO_2/1,000 kg WO)

Rerefining	Thermal cracking/ refinery recycling		Cement kiln	plant
(150) – (320)	(500) – (200)	50	(1,200)	(200)

Source: European Commission, 2001.

As noted in Table 75, greenhouse gas savings of re-refining are 320 kg eCO_2 per 1,000 kg of used oil and 1,200 kg eCO_2 per 1,000 kg for the burning of used oil in a cement kiln. Greenhouse gas savings are achieved predominately through avoided virgin oil production and avoided combustion. See Figure 8 and Figure 9 for a summary level synopsis of where GHG impacts occur by re-refining waste and burning used oil in a cement kiln respectively.

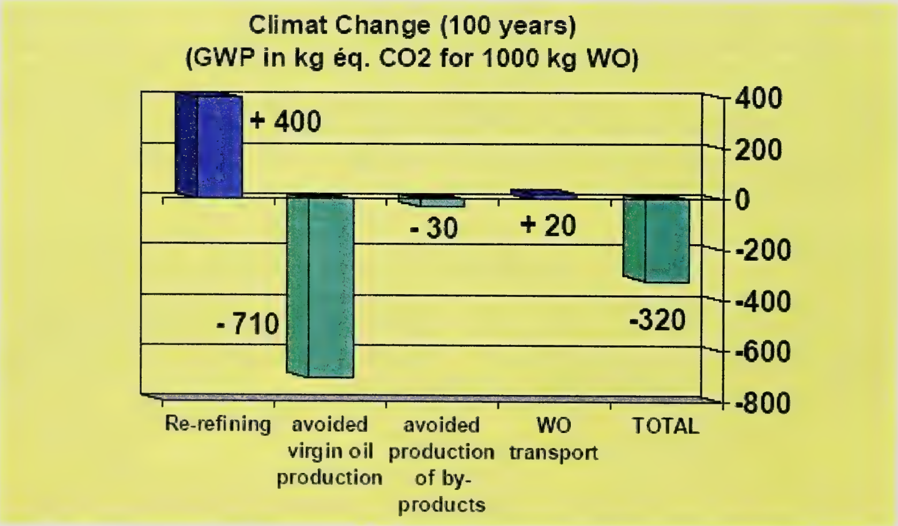


Figure 8: Greenhouse Gas Impacts – Re-Refining Used Oil

Source: European Commission, 2001.

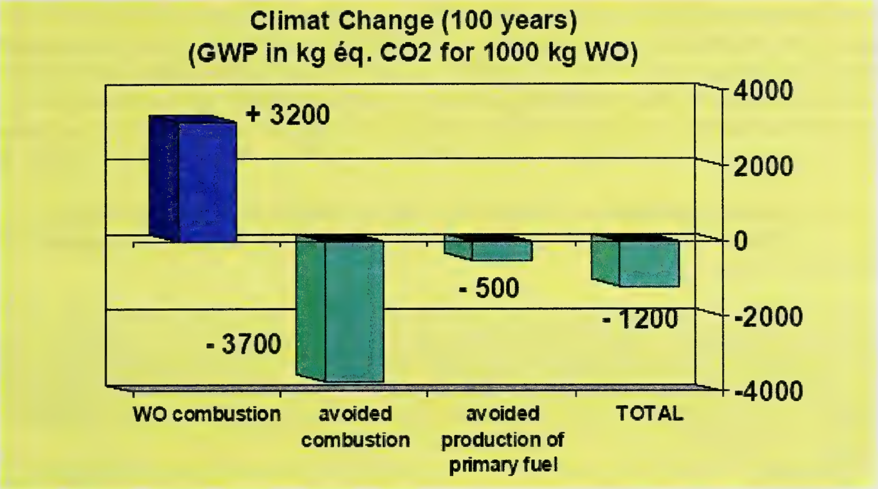


Figure 9: Greenhouse Gas Impacts by Burning Used Oil in Cement Kilns

Source: European Commission, 2001.

A report by Safety-Kleen Canada (2003) referencing Canadian programs found that every litre of recovered used lubricating oil that is reused and recycled avoids an estimated 2.9 kg of carbon dioxide equivalent emissions. These avoided emissions are associated with; a) what would have been generated if the used oil were to be burned unprocessed as heating or marine diesel fuel; and b) with having to replace the burned oil with a new litre of lubricating oil made from crude oil (which generates "upstream" emissions through its extraction, transport and refining). This value equates to 3.2 kg of CO_2, based on an average density of oil of 0.9 kg/litre (SI Metric, 2006).

Using the ranges of values for GHG impacts provided by the European Commission report (2001) and the Safety-Kleen Canada study (2003) and applying them to the final disposition of used oil in 2004 provides the following GHG impact ranges.

Table 76: GHG Savings (Avoided Emissions) by Used Oil End Use (2004)

Used Oil End use	litres	GHG factor (low)	GHG factor (high)	GHG impact (low) (MTCE*)	GHG impact (high) (MTCE*)
re-refined lubricating base oil	15,742,687	0.15	3.20	2,125	45,339
reprocessed petroleum products	16,336,365	0.05	0.20	735	2,941
large industrial plant heating oil	7,056,056	1.20	1.20	7,621	7,621
asphalt plant heating oil	30,286,150	0.20	0.20	5,452	5,452
Total	**69,421,258**	**0.26**	**0.98**	**15,933**	**61,353**

*metric tonnes of carbon equivalent

Sources: AUOMA, 2005; European Commission, 2001; Safety-Kleen, 2003.

As a GHG factor for space heaters were not available we did not include it in our analysis. We rationalized this based on the fact that used oil used in small space heater applications is marginal. The per litre GHG impacts are recognized to be less than the other used oil destinations further suggesting a marginal impact on final estimates. The total amount of used oil used as small space heater heating oil in 2004 was just over 3 million litres or 4% of total used oil reused.

In 2004, the estimated avoided GHG emissions as a result of recovering used oil ranges from **16,000 metric tonnes of CO_2 equivalent to 61,000 metric tonnes of CO_2 equivalent.**

The AUOMA estimate of oil collected prior to the program introduction in 1998 was 40 million litres (Corporate Link, 2002). The final destinations of this oil are unclear, so it is difficult to quantify the previous GHG implications. However, assuming a final disposition similar to that today, pre-program greenhouse gas savings which could be attributed to reusing used oil ranges from 10,200 to 39,300 metric tonnes of CO_2 equivalent. This implies marginal GHG **savings in 2004 versus pre-program levels (1997) of 5,700 to 22,075 metric tonnes of CO_2 equivalent.**

The estimated greenhouse savings which can be attributed to reusing used oil if Alberta had no program in 2004 (assuming a continued pre-program recovery rate of 56%) ranges between 13,500 and 51,900 metric tonnes of CO_2 equivalent. Therefore having a program in 2004 versus not having a program in 2004 resulted in a GHG savings of **2,467 to 9,498 metric tonnes of CO_2 equivalent.**

Table 77 summarizes the estimated GHG savings attributed to reusing used oil based on total savings for the year 2004, marginal savings 2004 vs. 1997 and program vs. no program (56% recovery rate).

Table 77: Summary of Estimated GHG Savings Attributed to Reusing Used Oil

Estimated GHG savings attributed to reusing used oil	Litres	GHG impact (low) (MTCE)	GHG impact (high) (MTCE)
2004 (total)	69,421,258	15,933	61,353
Marginal savings 2004 vs. 1997	29,421,258	5,733	22,075
Savings program vs. no program (56% recovery rate)	16,613,258	2,467	9,498

Sources: Corporate Link, 2002; AUOMA, 2005a.

This report estimates a high end per tonne eCO_2 value based on the social cost of carbon used in Britain's Stern Review on the Economics of Climate Change (2006). The review calculates the damage done over time by a tonne of CO_2 emitted this year, if the world continues on a business-as-usual (BAU) scenario. The social cost of carbon under the BAU is estimated at US\$85/tCO_2 (2000\$) now, and rising over time. We converted the current value as C\$141.66/tCO_2 (2005\$). It is important to note that the Stern Review is based on the latest science, which predicts greater increases in global average temperature (at least 5 degrees Celsius, compared with previous estimates of 2-3 degrees Celsius).

As a low end per tonne eCO_2 value we use the European carbon trading market value which we estimate at C$7.48/tC (4.37 Euros/tC) based on April 4, 2006 trading values. This translates to C$27.45/$tCO_2$. We recognize that the true value may very well fall in between these limits and therefore as a middle value estimate selected the mid point between the Stern Review cost of carbon value and the European carbon trading market value. The proposed middle estimate is $84.56/tonne eCO_2.

Table 78 highlights possible greenhouse gas reduction benefit values based on the established per tonne eCO_2 range estimates being used for this report.

Table 78: Greenhouse Gas Reduction Benefits ($ Range Low, Medium, High)

Estimated GHG $ reduction benefits	GHGs avoided (low impact scenario)	Low estimate ($27/ tonne CO2)	Medium estimate ($85/ tonne CO2)	High estimate ($142/ tonne CO2)
Total Benefit (2004)	15,933	$437,386	$1,347,243	$2,257,101
Marginal savings 2004 vs. 1997	5,733	$157,380	$484,764	$812,148
Marginal savings program vs. no program (56% recovery rate)	2,467	$67,723	$208,602	$349,480
Estimated GHG $ reduction benefits	**GHGs avoided (high impact scenario)**	**Low estimate ($27/ tonne CO2)**	**Medium estimate ($85/ tonne CO2)**	**High estimate ($142/ tonne CO2)**
Total Benefit (2004)	61,353	$1,684,238	$5,187,813	$8,691,389
Marginal savings 2004 vs. 1997	22,075	$605,994	$1,866,591	$3,127,189
Marginal savings program vs. no program (56% recovery rate)	9,498	$260,735	$803,120	$1,345,506

- ***Greenhouse gas reduction benefit 2004: $437,000 – $8,691,000***
- ***Net marginal greenhouse gas reduction benefit 2004 vs. 1997: $157,000 – $3,127,000***
- ***Net marginal greenhouse gas reduction benefit program vs. no program (56% recovery rate): $68,000 – $1,346,000***

6.6.2.1.2 Used Oil Filters

6.4 million used oil filters were collected in 2004. Used oil filters are recycled into steel. 6.4 million filters contain approximately 2,200 tonnes of steel (CIWMB, 2006). The established ICF Consulting (2005) greenhouse gas emissions factor for recycling steel is 1.16 MTCE/ tonne. Therefore, recycling used oil filters in 2004 **provided an estimated greenhouse gas savings of 2,550 tonnes of CO_2 equivalent**.

Estimated pre-program collections were approximately 1 million used filters annually (Corporate Link, 2002). This translates into avoided greenhouse gas emissions of

400 MTCE. Therefore, the marginal greenhouse gases **savings in 2004 versus pre-program levels are 2,150 metric tonnes of CO_2 equivalent.**

The estimated greenhouse savings which can be attributed to recycling oil filters if Alberta had no program in 2004 (assuming a pre-program oil filter recovery rate of 17%) is 518 metric tonnes of CO_2 equivalent. The marginal savings of having a program in 2004 versus not having a program under this scenario is **approximately 2,000 metric tonnes of CO_2 equivalent.**

Table 79 summarizes the estimated GHG savings attributed to recycling oil filters based on total savings 2004, marginal savings 2004 vs. 1997, and marginal savings of program vs. no program (17% recovery rate).

Table 79: Summary of Estimated GHG Savings Attributed to Recycling Oil Filters

Estimated GHG savings attributed to recycling oil filters	Oil filters	of steel	GHG factor	GHG impact (MTCE)
2004	6,400,000	2,200	1.16	2,552
Marginal savings 2004 vs. 1997	5,400,000	1,856	1.16	2,153
Marginal Savings program vs. no program (17% recovery rate)	5,100,000	1,753	1.16	2,034

Sources: Corporate Link, 2002; AUOMA, 2005a; ICF Consulting, 2005.

This report estimates a high end per tonne eCO_2 value based on the social cost of carbon used in Britain's Stern Review on the Economics of Climate Change (2006). The review calculates the damage done over time by a tonne of CO_2 emitted this year, if the world continues on a business-as-usual (BAU) scenario. The social cost of carbon under the BAU is estimated at US\$85/tCO_2 (2000\$) now, and rising over time. We converted the current value as C\$142/tCO_2 (2005\$). It is important to note that the Stern Review is based on the latest science, which predicts greater increases in global average temperature (at least 5 degrees Celsius, compared with previous estimates of 2-3 degrees Celsius).

As a low end per tonne eCO_2 value we use the European carbon trading market value which we estimate at C\$7.48/tC (4.37 Euros/tC) based on April 4, 2006 trading values. This translates to C\$27/tCO_2. We recognize that the true value may very well fall in between these limits and therefore as a middle value estimate selected the mid point between the Stern Review cost of carbon value and the European carbon trading market value. The proposed middle estimate is \$85/tonne eCO_2.

Table 80 highlights possible greenhouse gas reduction benefits based on the established value per tonne eCO_2 range being used for this report.

Table 80: Greenhouse Gas Reduction Benefits ($ Range Low, Medium, High)

Estimated GHG $ reduction benefits	GHG avoided	Low estimate	Medium estimate	High estimate
Total Benefit (2004)	2,552	$70,056	$215,789	$361,521
Marginal savings 2004 vs. 1997	2,153	$59,103	$182,051	$304,998
Savings program vs. no program (17% recovery rate)	2,034	$55,837	$171,989	$288,141

- ***Greenhouse gas reduction benefit 2004: $32,028 - $519,051***
- ***Marginal greenhouse gas reduction benefit 2004 vs. 1997: $27,023 – $437,950***
- ***Marginal greenhouse gas reduction benefit program vs. no program (17% recovery rate): $25,522 – $413,619***

6.6.2.1.3 Plastic Oil Containers

Plastic oil containers are predominantly HDPE. 1.3 million kg of plastic oil containers were collected through the program in 2004. Applying the ICF Consulting (2005) greenhouse gas emissions factor for recycling plastic (HDPE) of 2.29 MTCE/ tonne produces **a greenhouse gas savings of 3000 tonnes of CO_2 equivalent**.

It is estimated that approximately 200,000 kilograms of plastic oil containers were recycled in the pre-program year (Corporate Link, 2002). This translates into greenhouse gas savings of 458 tonnes of CO_2 equivalent. The marginal greenhouse gases **savings in 2004 versus pre-program levels are 2.6 million metric tonnes of CO_2 equivalent.**

The reported weight of containers sold has remained relatively stable since the introduction of the program (Corporate Link, 2002; AUOMA, 2005a). It is estimated that the same number of containers would have been collected in 2004 if the program had not been introduced. The estimated greenhouse savings which can be attributed to recycling oil containers if Alberta had no program in 2004 (assuming a pre-program oil container recovery rate of 7%) is 458,000 tonnes of CO_2 equivalent. The same level as those achieved in 1997. Despite expansions in municipal recycling programs over that time, the inherent contamination of used oil containers make them less desirable than other sources of HDPE in the waste stream as they require specialized processing. Therefore, it is reasonable to assume that, in absence of the program's financial incentives, collection of used oil containers would not have increased substantially over pre-program rates.

Table 81 summarizes the estimated GHG savings attributed to recycling plastic oil containers based on total savings 2004, marginal savings 2004 vs. 1997 and marginal savings of program vs. no program (7% recovery rate).

Table 81: Summary of Estimated GHG Savings Attributed to Recycling Oil Containers

Estimated GHG savings attributed to recycling oil containers	Kilograms of oil containers		GHG impact (MTCE)
2004	1,334,191	2.29	3,055
Marginal savings 2004 vs. 1997	1,134,191	2.29	2,597
Savings program vs. no program (7% recovery rate)	1,134,191	2.29	2,597

Sources: Corporate Link, 2002; AUOMA, 2005a; ICF Consulting, 2005.

Table 82 highlights possible greenhouse gas reduction benefits based on the established value per tonne eCO_2 range being used for this report. Estimates are provided for total benefit as a result of recycling plastic oil containers in 2004, the net marginal benefit of recycling plastic oil containers in 2004 versus 1997, and the net marginal benefit of having a program versus not having a program (7% recovery rate).

Table 82: Greenhouse Gas Reduction Benefits ($ Range Low, Medium, High)

Estimated GHG $ reduction benefits	GHG avoided	Low estimate	Medium estimate	High estimate
Total Benefit (2004)	3,055	$83,873	$258,346	$432,820
Marginal savings 2004 vs. 1997	2,597	$71,300	$219,619	$367,938
Savings program vs. no program (7% recovery rate)	2,597	$71,300	$219,619	$367,938

- ***Greenhouse gas reduction benefit 2004: $84,000 – $433,000***
- ***Marginal greenhouse gas reduction benefit 2004 vs. 1997: $71,000 – $368,000***
- ***Marginal greenhouse gas reduction benefit program vs. no program (7%): $$71,000 – $368,000***

6.6.2.2 Summary – Greenhouse Gas Reduction Benefit

Table 83 below provides a summary of total greenhouse gas reduction benefits as a result of the Alberta oil stewardship program. The low GHG impact estimates are used for used oil.

Table 83: Greenhouse Gas Reduction Benefits ($ Range Low, Medium, High)

Estimated GHG $ reduction benefits – oil stewardship program summary*	Low estimate	Medium estimate	High estimate
2004	$591,316	$1,821,379	$3,051,442
Marginal savings 2004 vs. 1997	$287,783	$886,434	$1,485,085
Savings program vs. no program	$194,860	$600,209	$1,005,559

- ***Greenhouse gas reduction benefit 2004: $270,331 – $4,381,081***
- ***Marginal greenhouse gas reduction benefit 2004 vs. 1997: $131,566 – $2,132,214***
- ***Marginal greenhouse gas reduction benefit program vs. no program: $89,076 – $1,443,592***

6.6.3 Extended Landfill Life

6.6.3.1 Disposal Costs

In assessing a reasonable value for landfill cost, it could be argued that landfills operated by the private sector are profit driven and may better reflect actual costs. Essentially, the operations of a private-sector company are bound to be profitable by the expectations of its shareholders. Therefore, private landfill operators must account for all direct and potential costs associated with their operations. It is reasonable, then, to suggest that the rates charged by private landfills are a good proxy of the full costs, excepting those costs borne by society as a whole.

Discussions with Waste Management Inc., have concluded that the average gate rate at a private landfill is approximately $42/tonne (Hantiuk, 2006).

An average of landfill tipping fees across Alberta as reported to Alberta Environment in 2005 was $37/tonne. This suggests a similar range to the private sector costs above.

It is often asserted by waste reduction advocates that the costs of landfill disposal are generally underestimated, and that the full costs of operating a landfill are not reflected in the tipping fee. By not accounting for the full costs of landfill disposal, alternative measure such as recycling and composting are placed at an economic disadvantage.

In many cases, only direct capital and operating costs are taken into account when determining landfill costs. It is recognized that indirect costs, including health risks, property value depreciation, environmental risks, lost opportunity and quality of life must also be taken into account (AOW, 1995).

The $42/tonne disposal estimate for private landfills does not include costs borne by society in general, potentially neglected future siting costs, unanticipated closure and post closure costs, nor the nuisance costs and potential loss of property value costs borne by neighbouring residents and potential future environmental pollution risks.

A University of Toronto Department of Economics report on municipal user fees suggested that the net marginal social costs for landfill disposal were in excess of \$50/tonne in the Toronto region, while as low as \$30/tonne in other regions of Canada (Dewees, 2002). Adding these social costs would suggest a full valuation of landfill at \$72-\$92/tonne.

Compacted garbage has a density of 1,200-1,500 pounds/yd^3 (CSR, 2003). Based on this, one tonne of garbage takes up 1.5-1.8 yd^3. Therefore, a landfill cost of \$72/tonne would translate into approximately \$40-\$48/yd^3, whereas \$92/tonne would equate to \$51-\$61/yd^3.

Therefore we estimate a landfill disposal cost range of:

- Low: \$40/yd^3
- Medium: \$50/yd^3
- High: \$61/yd^3

For the oil stewardship program we include the extended landfill life as a result of recycling used oil containers and oil filters. CM Consulting has presented a landfill equivalency value of 14.06 yd^3/tonne for HDPE (2002). Using this value, the 1.3 million kg of plastic oil containers recycled in 2004 represents a landfill space savings of approximately 18,000 yd^3. Containers recycled prior to the program would have taken up 3,000 yd^3 of landfill space. As the number of oil containers sold has remained stable since 1997 no program in 2004 (7% recovery rate) would also translate into saved landfill space of 3,000 yd^3.

1 tonne of used oil filters has been estimated to take up 10 yd^3 of landfill space, with approximately 2,722 filters per metric tonne (Minnesota Pollution Control Agency, 2001).[22] Using these estimates, the filters recycled in 2004 would have consumed approximately 21,000 yd^3 of landfill space. The filters estimated to have been diverted prior to the program would have taken up 3,500 yd^3 of landfill space. Assuming no program in 2004 (17% recovery rate), the estimated number of filters recycled would have taken up 4,600 yd^3 of landfill space.

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[22] 2722 filters per metric tonne = 3000 filters per ton

Table 84: Extended Landfill Life ($ Range Low, Medium, High)

Extended landfill life	Space saved through recycling (cubic yards)	Low estimate ($40/yd^3)	Medium estimate ($50/yd^3)	High estimate ($61/yd^3)
Program 2004	39,000	$1,560,000	$1,950,000	$2,379,000
Pre-program	6,500	$260,000	$325,000	$396,500
No program	7,600	$304,000	$380,000	$463,600
Marginal benefit 2004 vs. 1997	32,500	$1,300,000	$1,625,000	$1,982,500
Marginal benefit program vs. no program	31,400	$1,256,000	$1,570,000	$1,915,400

Sources: Minnesota Pollution Control Agency, 2001; CM Consulting, 2002; AUOMA, 2005a.

- ***Extended landfill life benefit 2004: $1.6 million – $2.4 million***
- ***Marginal extended landfill life benefit 2004 vs. 1997: $1.3 million – $2 million***
- ***Marginal extended landfill life benefit program vs. no program (pre-program recovery rates): $1.3 million – $1.9 million***

6.6.3.2 Avoided Siting Costs

The above extended landfill life values have factored in avoided siting costs. To demonstrate the significance of siting costs we have separated this component out. The following list overviews costs examples associated with siting a landfill referenced in the GPI Atlantic cost benefit analysis of the Nova Scotia solid waste system (2004).

- Regional District of Kootenay, BC – $3-$4 million
- Ontario Municipalities (research and siting costs) – $2.16/tonne (2000$);
- Halton, Ontario – $2/tonne (1996$);
- Landfills serving large municipalities – $1.43-$1.58/tonne (1996$)
- Otter Lake facility serving Halifax Regional Municipality – $0.55/tonne (2000$)

The values referenced in the GPI Atlantic report give an avoided siting cost range of $0.55/tonne to $2.16/tonne (2000$). Updating these values to 2004$ using the consumer price index gives a range of $0.60/tonne to $2.37/tonne.[23]

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[23] The consumer price index between 2000 and 2004 increased by 9.8% (Statistics Canada, 2006).

Table 85: Avoided Siting Costs

Avoided siting costs	Space saved recycling filters (tonnes)	Space saved recycling containers (tonnes)	Low estimate ($0.60/tonne)	High estimate ($2.37/tonne)
Program 2004	6,400	1,300	$4,620	$18,249
Pre-program	1,000	200	$720	$2,844
No program	1,300	200	$900	$3,555
Net marginal benefit 2004 vs. pre-program	5,400	1,100	$3,900	$15,405
Net marginal benefit program vs. no program	5,100	1,100	$3,720	$14,694

Sources: GPI Atlantic, 2004; AUOMA, 2005a.

- **Avoided siting costs savings (2004): $4,600 – $18,000**
- **Avoided siting costs savings *2004 vs. pre-program: $4,000 – $15,000***
- **Avoided siting costs savings *program vs. no program (pre-program recovery rates): $3,700 – $15,000***

6.6.4 Avoided Materials

The steel from oil filters is recycled into new steel products offsetting raw material extraction and processing involved with steel manufacturing. Table 86 reviews the amount of virgin steel replaced and the direct market value for recycled steel feedstock. Recycled steel feedstock is valued at $20/tonne (RCA, 2005).

Table 86: Avoided Material (Steel)

Avoided material (steel)	Oil filters collected	Tonnes of steel recycled	Value ($20/tonne)*
2004	6,400,000	2,200	$44,000
1997	1,000,000	344	$6,880
No program (17% recovery rate)	1,300,000	447	$8,940

* Recycled steel feedstock valued for calculation at $20 per tome for 1997 and 2004.

Source: AUOMA, 2005a; RCA, 2005.

Plastic oil containers are recycled into new containers and other products such as plastic flowerpots, plastic pipe, fence posts and plastic patio furniture (Corporate Link, 2002). The recycled products replace raw resources or virgin plastics. Table 87 reviews the direct market value for recycled HDPE feedstock which is valued at a market price of approximately $100/tonne (RCA, 2005).

Table 87: Avoided Material (Various)

Avoided material (various)	Oil containers recycled (tonnes)	Value ($100/tonne)
2004	1,300	$100,300
1997	200	$20,000
No program (17% recovery rate)	200	$20,000

Sources: AUOMA 2005a

Direct avoided raw material savings (2004):

- avoided steel use: $44,000
- use of recycled HDPE plastic: $100,300

  - ***Avoided raw material savings (2004): $144,000***
  - ***Marginal avoided raw material savings 2004 vs. 1997: $117,000***
  - ***Marginal avoided raw material savings program vs. no program (pre-program recovery rates): $115,000***

These estimates do not include the avoided extraction, processing, and transportation costs of replacing raw materials. It refers only to the estimated market value of recycled steel and HDPE feedstock. This is clearly a significant under-representation of the true savings achieved by replacing raw materials with recycled alternatives.

6.6.5 Energy Savings

The Europia report (2005) presents the following estimates of energy savings:

Table 88: Energy Savings (Estimates)

Recycle method	Crude oil saved (t/t used oil)	Savings over Clay treatment t/t
Clay treatment	0.86	—
MRD Process	0.93	0.07
Hydrogenation	0.89	0.03
Combustion in Cement Kilns	0.98	0.12

Source: Europia report (2005)

Using an average crude oil savings of 0.9 tonnes/tonne of used oil would results in a total savings of ~59,000 tonnes of crude oil, or ~423,000 barrels.

The European Commission study (2001) presents estimated energy savings of 40 GJ/1,000 kg of used oil for all management options, which is also equivalent to 37.9 million BTUs/tonne of used oil. Therefore, the volumes collected in 2004 represent 2.5 x 10^{12} BTUs of energy savings. 1 barrel of crude oil is equivalent to approximately 5.8 million BTUs, making the energy savings equivalent to ~426,000 barrels of oil.

Using an average oil price of $68.97/barrel (Bloomberg, 2005; Bank of Canada, 2006), this translates to an energy savings of approximately $29.4 million for the used oil collected in 2004. Energy savings due to used oil recovery pre-program (assuming current oil values) using an average annual oil price in 1997 of $29.95/barrel (EIA, 2006; Bank of Canada, 2006) would have been $7 million.

The energy savings of used oil without a formal program assuming a recovery rate of 57% and an average oil price of $68.97/barrel would translate into energy savings of approximately 21.4 million dollars. The marginal savings of having a program versus no program is $8.0 million dollars.

- ***Energy savings benefit (2004): $29.4 million***
- ***Marginal energy savings benefit 2004 vs. 1997: $22.3 million***
- ***Marginal energy savings benefit program vs. no program (pre-program recovery rates): $8 million***

6.6.6 Environmental and Human Health Liability

The potential environmental and human health impacts of used oil and associated materials are significant. The range of impact largely depends on final disposition. Common contaminants present in used oil and used oil residue in used filters and containers include trace metals, chlorinated solvents, gasoline and products of incomplete combustion, polynuclear aromatic hydrocarbons, glycols, and PCBs.[24]

6.6.6.1 Water

The oil stewardship program in Alberta was largely driven by increasing concern about the potential environmental and human health liability costs of used oil entering the environment, especially water systems.

Oil concentrations as small as one part per million can contaminate drinking water supplies (Nixon and Saphores, 2006). The potential human health impact is serious as the oil-based compounds are easily absorbed by soft tissues.

Oil contaminated water also poses a significant threat to wildlife including the loss of food resources and habitats, immune system dysfunction and reproductive problems (Nixon and Saphores, 2006).

Used oil can contaminate up to 1 million times its volume of water. According to collection volumes and rates, 21.8 million litres of recoverable used oil were not collected in 2004. While the final disposition of this oil is unknown, it presents the potential to contaminate 21.8 trillion litres of water.

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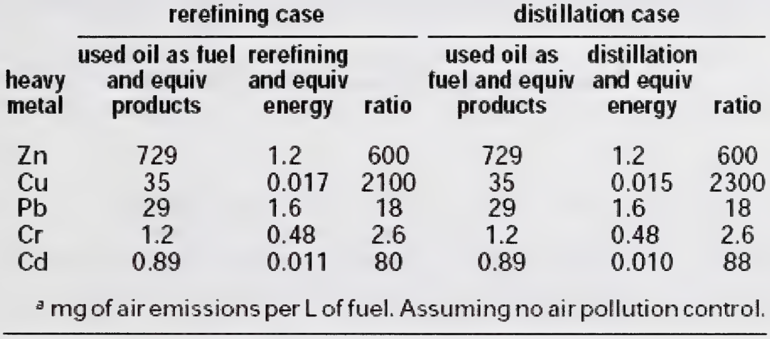
[24] Used oil filters can contain more than 45% used motor oil in weight when removed from the vehicle (CIWMB, 2006), and even when properly drained for 12 hours, they still contain two to eight ounces of used oil (Minnesota Pollution Control Agency, 2001). Placement of used oil filters in landfills presents risks associated with this residual oil.

The Minnesota Pollution Control Agency (2001) quantified the costs of treating contaminated water at up to $2 US per gallon or $0.32 per litre.[25] While it is unknown what percentage of used oil ends up in water systems, the direct clean-up costs alone have the potential to be very significant.

6.6.6.2 Air Emissions

A report by Boughton (2003) prepared for the State of California reviews pollution issues associated with used oil management. The following copied table presents the relative emissions of heavy metals to the air for re-refining and distillation, as compared to used oil as fuel.

Table 89: Inventory of Key Heavy Metal Air Emissions Based on Equivalent Functional Units[a]



	rerefining case			distillation case		
heavy metal	used oil as fuel and equiv products	rerefining and equiv energy	ratio	used oil as fuel and equiv products	distillation and equiv energy	ratio
Zn	729	1.2	600	729	1.2	600
Cu	35	0.017	2100	35	0.015	2300
Pb	29	1.6	18	29	1.6	18
Cr	1.2	0.48	2.6	1.2	0.48	2.6
Cd	0.89	0.011	80	0.89	0.010	88

[a] mg of air emissions per L of fuel. Assuming no air pollution control.

Source: Boughton, 2003.

As can be seen, heavy metal air emissions are primarily a concern when the used oil is burned as untreated fuel with no pollution controls. This is of course mitigated to varying degrees by pre-treatment of the fuel and by pollution-control mechanisms.

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[25] The average 2005 US$ to CAN$ conversion rate is $1.21 CAN per $1.00 US$ (Bank of Canada, 2006).

The European Commission study (2001) presents the following pollution impacts:

Table 90: Pollution Impacts

	Rerefining	Refined fuel	Asphalt plants	Cement kilns
Acidifying potential (g eq SO_2/1,000 kg WO)	(3,700) - 100	(1,500) - 0	50	(3,100) - (300)
Hydrocarbon emissions (g/1000 kg WO)	(3,000)	(1,000)	(7,000)	(7,000)
Particle emissions (g/1000 kg WO)	(200) - (20)	(200) - (20)	(200)	(400) - (2)
Human toxicity (g eq arsenic/1,000 kg WO)	(1)	(0.9)		(0.1)
Eutrophication potential (g eq PO_4/1,000 kg WO)	(1) - 10	(1) - 0	0	(10) - 0

Source: European Commission Study, 2001.

6.6.6.3 Soil

Not properly managed used oil can contaminate soil. This is especially problematic in agriculture regions. The impact of used oil on soil systems depends on several factors including soil characteristics, the type and concentration of oil, and the frequency of dumpings. Table 91 overviews these factors and the subsequent soil impacts.

Table 91: Soil Impacts

Factor	Potential Impacts
Soil type	Some soil types are more porous than others. In some cases, the oil would not seep into the soil at any great rate but would instead run off to another location. Other times, all the oil would be absorbed by the soil and little run-off would occur.
Level of moisture/saturation	A high water table could pose more of a problem because discarded used oil could more easily seep into it.
Oil concentration	The higher the concentration of used oil, the higher the likelihood of soil or water contamination. If a site is constantly being "dumped on," the higher the likelihood that the site would pose a threat to water and vegetation.
Frequency between "dumpings"	More frequent dumping overloads the capacity of microbes to break down the soil.
Compaction (run-off potential)	Compact soils can increase the rate of oil run-off.
Slope (run-off potential)	Run-off potential can increase dramatically in soils with high slopes.
Heavy metals in oil (type and concentration)	Concentrations of certain heavy metals (*e.g.*, lead, cadmium, etc.) can build up to high levels in soils.

Source: Minnesota Pollution Control Agency, 2001.

The range of variable factors influencing the potential severity of improper disposal of used oil on soil makes it difficult to determine a specific clean up cost factor (Minnesota Pollution Control Agency, 2001). Costs associated with cleaning up contaminated soil in Alberta are in the range of $160/tonne, based on discussions with reclamation experts. The actual costs will vary depending on the degree of oil contamination.

6.6.6.4 Direct Employment

While there are no official figures accounting for the number of jobs which have been generated as a result of the oil stewardship program, estimates based on discussions with processors, collectors, and AUOMA suggest that it is upward of one hundred jobs (see Table 92).

Table 92: Employment Estimates Attributed to Stewardship Program

Employment Category	Full Time Equivalent Positions
Positions supporting filter recovery	30
Positions supporting container recovery	24
Administrative positions	44
Total	**98**

We account only for those jobs which can be attributed specifically to having an oil stewardship program as opposed to not having a formalized program. For example given the current high costs of oil we do not credit any of jobs related to the collection and processing of used oil as that market would likely exist independently of the stewardship program.

For oil filter collection, trying to determine the number of jobs resulting from the program is difficult. While recovery has increased by 67% since the inception of the program, with the current high cost of oil, combined with stronger hazardous waste disposal regulations, it is uncertain what type of market would exist otherwise. Based on discussions with processors and collectors we estimate that half of the jobs are a result of the oil stewardship program.

As for used oil containers, it is assumed that most of these jobs can be attributed to the program given that the incentives provided by AUOMA clearly drive this market.

It is not known if the jobs generated by the used oil stewardship program have led to a reduction in overall unemployment in the province. From a full cost benefit perspective it is important to distinguish between new jobs and a transfer of workers from one sector of the economy to another. It is possible that a portion of the jobs supported by the oil stewardship program may have simply been a transfer of jobs caused by a change in how used oil and associated materials are handled. This is a stronger likelihood in regions of low unemployment. The new jobs may also have come at the expense of potential jobs in other sectors of the economy if the increased expenditure on waste management meant that there was less expenditure in other economic sectors (European Commission, 2001a).

A study sponsored by the Directorate-General Environment of the European Commission (2001a) concluded that waste management measures are likely to have only a small effect, either positive or negative, on employment. The conclusion challenges the common perception that recycling and other waste management activities stimulate new employment (especially for the socially excluded or the low skilled).

Levels of unemployment in Alberta are at an all time low. The average unemployment rate in 2004 was 4.6%. Given the lack of workers seeking employment in the province it is difficult to know if the jobs associated with the oil stewardship program facilitated employment leading to a decrease in people looking for work.

A conservative estimate of the benefit of employment is to adjust the total employment potential by the unemployment rate to account for job growth that would not otherwise be filled in the economy. In this case we adjust the total direct employment potential by the Alberta unemployment rate of 4.6%. What is not understood for Alberta is what percentage of these jobs were filled by an in-migration of workers. An influx of workers suggests that these jobs were potentially filled by people seeking work. Between the years 2000 and 2005, there was a net increase in inter-provincial migration of 110,000 people to Alberta from other provinces. To account for jobs being filled by an influx of workers we derived a medium and high estimate of the contribution of employment by adjusting the total employment potential by the Canadian average unemployment rate and the unemployment in Newfoundland and Labrador, the province with the highest unemployment rate. The unemployment rates for Canada and Newfoundland and Labrador in 2004 were 7.2% and 15.7% respectively.

Jobs supported by the oil stewardship program – 98 jobs

Seasonally Adjusted Average Weekly Earnings:
Administrative and support, waste management and remediation services
August 2005: Alberta – $653.10 per week / $33,961 per year (Statistics Canada, 2006).

Direct employment potential: 98 jobs x $33,961 = $3,328,178

Table 93: Direct Employment Benefits of Used Oil Materials Recycling Program

	Low estimate	Medium estimate	High estimate
Direct employment potential	$3,328,178	$3,328,178	$3,328,178
Unemployment rate	4.60%	7.20%	15.70%
Direct employment benefit	$153,096	$239,629	$522,524

- ***Direct employment benefit supported by the used oil materials recycling stewardship program: $153,000 – $523,000***

6.6.6.5 Indirect Employment

If direct employment increases, there is a 'multiplier effect' as those newly employed people spend their salaries on goods and services. This stimulates economic activity and can create additional employment in the sectors supplying those goods and services.

A study by R. Beck in 2001 estimated that every job in the recycling industry generates 1.3 spin-off jobs. This estimate has been referenced in other cost benefit analysis including the GPI Atlantic Nova Scotia Solid Waste Resource accounts (2003), which used Beck's estimate as a proxy to determine the benefits of indirect employment and economic spin-off.

There is some evidence to suggest, however, that indirect job estimates of 1.3 per direct job may be high. Similar to the conclusion for direct employment, the Directorate-General Environment of the European Commission study found that the indirect impact and induced impacts of employment are likely minimal given that increased expenditure on waste management often detracts from expenditures in other economic sectors resulting in lost jobs in those sectors. This is known as a 'crowding-out' effect (2001a).

The number of indirect jobs supported by the oil stewardship program if we use the 1.3 indirect jobs per direct job ratio is 98 x 1.3 = 127.4 jobs.

Average Weekly Earnings:
Sales and Services Occupations: November 2005: Alberta – $538.40 per week / $27,997 per year (Statistics Canada, 2006a).

Indirect employment potential: 127 x $27,997 = $3,555,619

Table 94: Indirect Employment Benefits of Used Oil Materials Recycling Program

	Low estimate	Medium estimate	High estimate
Indirect employment potential	$3,555,619	$3,555,619	$3,555,619
Unemployment rate	4.60%	7.20%	15.70%
Indirect employment benefit	$163,558	$256,005	$558,232

- ***Indirect employment benefit supported by the used oil materials recycling stewardship program: $164,000 – $558,000***

6.6.6.6 Community Investment

AUOMA does not directly fund research, technology and innovation, community projects, or clean up activities. While it encourages this type of activity through private sector investment, it does not engage directly in supporting these kinds of activities.

- ***Community investment benefit: $0***

6.6.6.7 Civic Pride / Community Image

While it is difficult to measure the impact of the oil stewardship program on community image, there is evidence to suggest that awareness and acceptance of the program is increasing. In 2004 ballots for the oil recycling summer promotion increased by 10.5% over 2003.

A public survey conducted in 2005 as part of the used oil management review found that 37% of respondents did not know about use oil management associations (Bearing Point, 2005). The urban-rural breakdown found that 39% of respondents living in urban areas did not know about used oil management associations while the percentage for rural areas was 34% (Bearing Point, 2005). This is the first public survey assessing awareness of the program so there is no baseline data to compare this to.

Public support for the program is also a potential measure of the social capital generated by the program; where social capital is defined by the level of trust citizens have that a government program or policy is contributed to the improved well-being of a society.

6.6.6.8 Environmental Stewardship

The more tangible natural capital benefits of the oil stewardship program are captured in such categories as avoided raw material use and reduced environmental liability. While more difficult to measure, the oil stewardship program provides an indirect benefit by helping to foster an environmental consciousness or ethic based on the principles of resource conservation and environmental protection.

7 Electronics

7.1 Review of Costs and Benefits

In the 2005/2006 fiscal year, providing an electronics recycling program from a purely bottom line economics perspective came with a total price tag of $7.1 million. Revenues to support the program were collected through an advance disposal surcharge (ADS) paid on the purchase of designated electronic products. Designated products include: televisions and computer products including monitors, CPUs, printers, and laptop notebooks.

Beyond the more readily apparent program costs and the tangible result of recovering almost 247,000 electronic products and recycling over 4,100 tonnes of material, there are several other costs and benefits associated with electronics recycling in the province. A simple review of the electronics recycling process for the 2005/2006 fiscal year highlights many non-traditional costs and benefits typically not considered in standard economic analyses associated with electronics recycling.

Electronics recycling in the province is overseen by Electronics Recycling Alberta (ERA), a division of the Alberta Recycling Management Authority (ARMA). ARMA is a Delegated Administrative Organization (DAO), reporting to the Minister of Environment. Electronics recycling is regulated under the Designated Material Recycling and Management Regulation.

In addition to facilitating and overseeing electronics recycling, ERA is responsible for providing public information and education regarding electronics recycling and supporting research and development into better recycling technologies.

Cost – 1: **Government oversight costs incurred through developing and supporting ERA program.**

Cost – 2: **Reduced competition and marketplace restrictions due to legislation regulating disposal options.**

Cost – 3: **Potential for decreased expenditure in other economic sectors due to investment in electronics recycling.**

Benefit – 1: **Increased employment (ARMA)**

Benefit – 2: **Expanded market potential for electronic recycling operations.**

Benefit – 3: **Benefits from investment in recycling technology research.**

In Alberta, consumers pay an advanced disposal surcharge (ADS) ranging from $5-$45 on the purchase of designated electronic products. Electronic suppliers remit this fee to Electronics Recycling Alberta (ERA). There are over 1,600 retailers registered with ERA.

Cost – 4: **Increased cost burden to consumers of ADS.**

Cost – 5: **Administration costs incurred by suppliers (collecting ADS, book-keeping work, remitting levy to ERA).**

Used electronic goods are collected at collection depots, select recycling depots or as part of electronic roundups. Collection agents (municipalities, depot owners) are compensated $50/tonne for material collected. The used electronic goods are temporarily stored at these locations and then transported from the various drop-off points to centralized processing facilities. There are currently six registered processors in the province. Previous to the program over 90% of electronic products were disposed of in landfills (ARMA, 2006).

Cost – 6: **Time costs incurred by consumers to dispose of electronics at drop-off points.**

Cost – 7: **Transportation costs incurred by consumers to dispose of electronics.**

Cost – 8: **GHG emissions associated with transportation, including transportation from consumers to drop-off points and drop-off points to centralized processing facilities.**

Cost – 9: **Reduced competition in recycling industry due to high standards restricting processor licenses.**

Cost – 10: **GHG emissions associated with processing electronics.**

Cost – 11: **Other environmental impacts associated with recycling electronics including air, land and water pollution, and any health and safety costs associated with this pollution.**

Benefit – 2: **Extended landfill life by not disposing of electronics in landfills including savings by delaying costs associated with siting a new landfill.**

Benefit – 3: **Energy and material savings gained by recycling electronics as opposed to using virgin material feedstocks.**

Benefit – 4: **GHG reductions gained by recycling electronics.**

Benefit – 5: **Reductions in air and water pollution achieved by recycling electronics.**

Benefit – 6: **Reduced environmental and human health liability associated with potential contamination caused by toxic materials present in electronics.**

Benefit – 7: **Reduced municipal waste collection costs by diverting material from the regular waste stream.**

Benefit – 8: **Increased employment at collection stations, processing facilities, and transportation agents.**

Benefit – 9: **Increase in civic pride associated with being a leader in recycling.**

Benefit – 10: **Benefits from investment in environmental stewardship including resource conservation and environmental protection benefits.**

7.2 Context of Analysis

Electronics recycling is a new program in the province. Collection officially started in October 2004 and the advanced disposal surcharge (ADS) went into effect in February 2005. Given the infancy of the program, this analysis is intended primarily to collect baseline data for future genuine wealth or other cost benefit type analyses. It does, however, also provide a static snapshot of the costs and benefits achieved in the first year of program operation. It is important to recognize in terms of volumes and costs that this will be an abnormal year as there are costs associated with the first year of the program that will be streamlined and reduced as time allows the system to optimize. In addition, the volumes entering the system in the first year are likely not reflective of a typical year as many electronic items have been stockpiled in household basements or business storage rooms. Furthermore, it is expected that household participation in the program will grow with greater public education and awareness and an expansion of drop-off locations.

7.2.1 Cost and Benefit Categories

This analysis specifically captures the costs and benefits for the 2005-06 fiscal year. This was the first full fiscal year in which the program was in effect. While this analysis attempts to attribute a monetary value to all categories, in several cases due to the lack of data or the inherent difficulty in monetizing social and natural capital, we describe the cost or benefit only. For a more detailed description of costs and benefits including how dollar values were estimated see Section 7.5.

Table 95 lists the costs and benefits and the associated evaluation methods of categories included in this review of the electronics stewardship program. For a list of all categories considered see Section 3.1 and Table 3.

Table 95: Summary of Costs and Benefits of Electronics Recycling Stewardship Program

	Evaluation Method	
Costs	**Monetary**	**Description**
ERA costs		
Program delivery	✓	✓
Surcharge Compliance Program Delivery	✓	✓
Recycling Incentive Programs	✓	✓
Administration	✓	✓
Fund Investment	✓	✓
Recycling Development	✓	✓
Supplier costs		
Supplier support	—	✓
Government costs		
Government policy development and program support	✓	✓
Consumer costs		
Advance Disposal Surcharge (ADS)	✓	✓
Household time	—	✓
Household transportation	—	✓
Disruption in marketplace		
Potential costs to businesses established prior to program	—	✓
Increased competition	—	✓
Environmental costs		
GHG emissions - transportation	—	✓
GHG emissions - processing	—	✓
Other environmental impacts	—	✓
Benefits		
Resource recovery benefits		
Reduction in GHG emissions	✓	✓
Extended landfill life	✓	✓
Energy savings	✓	✓
Reduced environmental and human health liability	—	✓
Employment		
Direct employment	✓	✓
Indirect employment	✓	✓
Community benefits		
Civic pride	—	✓
Environmental stewardship		
Resource conservation and environmental protection	—	✓

7.3 Costs and Benefits Valuation

Where feasible we attempted to attach a monetary value to the costs and benefits explored in this analysis of the electronics recycling program. A low, medium and high range is estimated for each category. The spread in range of estimates highlights the inherent challenges in valuation exercises.

As noted in Table 95 above, several cost and benefit categories were not monetized. This was either due to the infancy of the program, a lack of data to confidently assign a value or simply an acknowledgement that some non-traditional costs and benefits cannot adequately be valued in any meaningful way.

Categories not monetized include:

- Supplier costs
- Consumer transportation and time costs
- Disruption in the marketplace
- Environmental costs associated with recycling electronics
- Reduced environmental and human health liability
- Expanded market opportunities
- Civic pride
- Resource conservation / environmental protection

A summary of the monetized costs and benefits of the electronics recycling program, as summarized in Table 96, indicates the potential **range of a costs, from an overall net cost of $275,000 to $2.7 million. This is based on estimated program costs of $7.2 million and estimated program benefits ranging from $4.5 million to $6.5 million.**

The estimated total net marginal benefit (cost) per tonne of electronics recycled ranges from a cost of $174/tonne to $1,082/tonne. The estimated cost/benefit per Albertan ranges from a cost of $0.22 to $0.84. Table 96 provides a summary of the monetized cost and benefits of the electronics recycling program.

Table 96: Summary of Monetized Costs and Benefits

Electronics Recycling Program Costs and Benefits (fiscal year 2004-2005)			
Program Operating Revenues			
Revenues from ADS (paid by consumers on the purchase of 1,757,776 designated electronic goods)*		$23,447,975	
Other revenues/funds (ADS interest)		$10,589	
Total Revenues		**$23,458,564**	
Program Operating Costs			
Program operating costs		$7,119,909	
Recycling incentives		*$4,751,661*	
Recycling development		*$1,036,608*	
ADS program delivery		*$691,022*	
Administration		*$545,263*	
Fund Investment		*$95,405*	
Other Non-Program Societal Costs			
Government support		$103,142	
Disruption in marketplace		Not quantified	
Total Program Costs		**$7,223,051**	
Electronics recycled (05-06 fiscal year)		**247,000**	
Tonnes of material recycled		**4,160**	
Program costs per tonne of material recycled		**$1,736**	
	Low	**Medium**	**High**
Societal Benefits			
Reduction in GHG emissions	$118,000	$365,000	$611,000
Extended landfill life	$707,000	$884,000	$1,078,000
Energy Savings	$3,207,000	$3,207,000	$3,207,000
Direct employment	$227,000	$355,000	$773,000
Indirect employment	$243,000	$380,000	$829,000
Total Societal Benefits	**$4,502,000**	**$5,191,000**	**$6,498,000**
Net Annual Costs/Benefits	**-$2,721,000**	**-$2,032,000**	**-$725,000**
Net Annual Costs/Benefits per tonne recycled	**-$654**	**-$488**	**-$174**
Net Annual Costs/Benefits per Albertan**	**-$0.84**	**-$0.62**	**-$0.22**

* Revenues to deliver the electronics recycling program are generated through an advanced disposal surcharge (ADS) paid at the point of sale on all eligible electronics. Surcharges range from $5 to $45 dollars depending on the product. It is important to recognize that the product mix of electronics purchased will not necessarily reflect the product mix of electronics recycled given the lifespan of electronic products. The ADS collected on products today can be thought of as a trust that will allow these products to be recycled at the end of their lifespan.

** Assumes a population of 3,256,800.

Sources: This summary table synthesizes data from several tables. Please refer to tables in the costs and benefits description section for sources.

7.4 Monetary and Physical Description of Cost and Benefit Categories

In addition to attributing a monetary value to cost and benefit categories, this analysis also provides a physical description for each category. Table 97 highlights these results and includes a column identifying who bears the costs and who receives the benefits being described.

Please note that Table 97 is not a cost/benefit summary table. Row results are not commensurable and should not be added up. Monetary estimates and monetary estimates per tonne speak only to the line item which they reference. A detailed description of each of these line items is provided in Section 7.5. Table 96 (above) provides a summary of the costs and benefits.

Table 97: Cost-Benefit Analysis – (Fiscal 2005-06) (Monetary and Physical)

Genuine Wealth Analysis	Monetary	Monetary/ tonne recycled	Physical
Revenue			
Advance disposal surcharge (ADS)	$23,447,975 range: $5 - $45		Paid on 1,757,776 electronic products
Surcharge interest	$10,589		
Costs			
Program operating costs	$7,119,909 **Breakdown by exp. category** Recycling incentives: 67% Recycling development: 15% ADS program delivery: 10% Administration: 8% Fund Investment: 1%	$1,650	246,973 electronic products recycled (4,160 tonnes of material)
Supplier support	Not estimated		1,600 registered suppliers
Government support	$103,142	$24	On-going support days: days/ year
Consumer costs			
ADS	$23,447,975		Paid on 1,757,776 electronic products
Time	Not estimated		
Transportation	Not estimated		100 drop-off locations
Disruption in marketplace	Not estimated		# of processors expanded from 1 to 6 - Expanded marketplace/ increased competition; regulated market entry
Environmental costs			
GHG costs (transportation)	Not estimated		Increase in household transportation, and from drop-off points to processing centres.
GHG costs (processing)	Not estimated		
Other environmental costs	Not estimated		Esp. air and water pollution

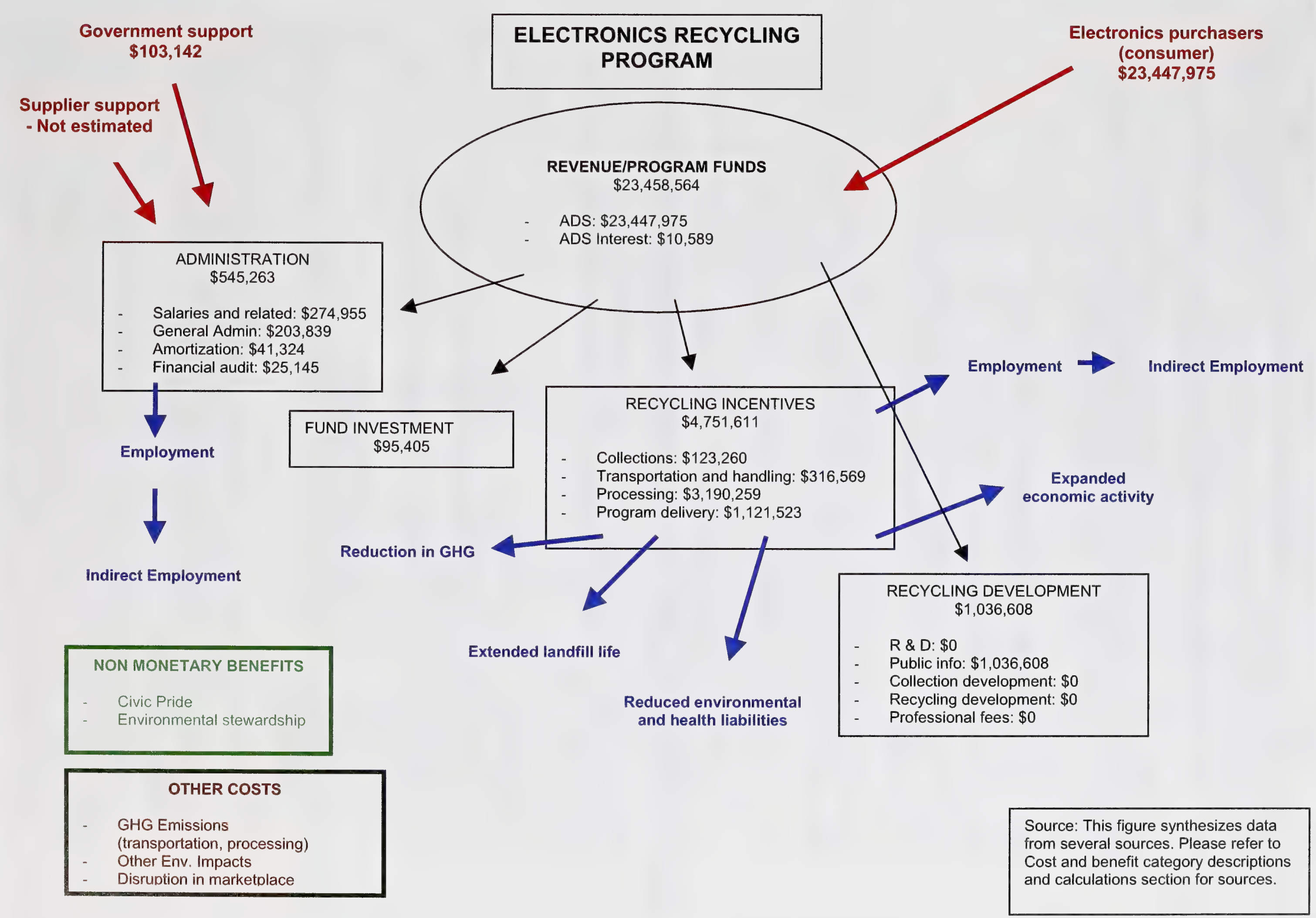
Benefits			
Reduced costs resulting from resource recovery			
Reduction in GHG emissions	\$118,000 - \$611,000 (\$27/tonne - \$142/tonne)	\$28 - \$147	Net reduction: (4,315) tonnes of eCO_2
Extended landfill life	\$707,000 - \$1,078,000 (low - \$17/m^3; high - \$22/m^3)	\$170 - \$259	17,680 yd^3
Avoided siting and operational costs	\$10,608 - \$41,902 (\$0.60/ tonne - \$2.37/ tonne) Values are included in extended landfill life benefit		
Energy savings	\$3,207,000 (oil price: \$60.63)	\$771	52,900 barrels of oil
Environmental and human health liability	Not estimated		**Materials diverted** Copper: 227 tonnes Lead: 214 tonnes Cadmium: 0.17 tonnes Mercury: 0.04 tonnes
Employment / Economic			
Direct employment	\$227,000 - \$773,000	\$54 - \$186	Jobs supported - 145
Indirect employment	\$243,000 - \$829,000	\$58 - \$199	Jobs supported – 189
Civic pride	Not estimated		First province in nation to initiate an electronics recycling program.
Environmental stewardship	Not estimated		

Sources: This summary table synthesizes data from several tables. Please refer to tables in the costs and benefits description section for sources.

7.5 Monetary Flow of Electronics Recycling Stewardship Program

7.5.1 Monetary Flow Analysis (2004)

The electronics recycling stewardship program is funded by an advance disposal surcharge (ADS) paid on all new electronic purchases. ARMA supported electronics recycling in the province in 2004 by directing over 67% of total program expenditures to collection, processing and transport and handling incentives. Of the remaining 33%, 15% was directed to public information, 10% to surcharge compliance program delivery and 8% went to administration. Figure 10 provides a schematic summary of how money flows through the tire recycling system. The value of non-traditional environmental and social cost and benefits are listed in the schematic diagram. To get a sense of the dollar value of these categories please refer to Table 97.


ELECTRONICS RECYCLING PROGRAM
Government support $103,142
Supplier support - Not estimated
Electronics purchasers (consumer) $23,447,975
REVENUE/PROGRAM FUNDS $23,458,564
- ADS: $23,447,975
- ADS Interest: $10,589
ADMINISTRATION $545,263
- Salaries and related: $274,955
- General Admin: $203,839
- Amortization: $41,324
- Financial audit: $25,145
FUND INVESTMENT $95,405
RECYCLING INCENTIVES $4,751,611
- Collections: $123,260
- Transportation and handling: $316,569
- Processing: $3,190,259
- Program delivery: $1,121,523
RECYCLING DEVELOPMENT $1,036,608
- R & D: $0
- Public info: $1,036,608
- Collection development: $0
- Recycling development: $0
- Professional fees: $0
Employment
Indirect Employment
Employment
Indirect Employment
Expanded economic activity
Reduction in GHG
Extended landfill life
Reduced environmental and health liabilities
NON MONETARY BENEFITS
- Civic Pride
- Environmental stewardship
OTHER COSTS
- GHG Emissions (transportation, processing)
- Other Env. Impacts
- Disruption in marketplace

Source: This figure synthesizes data from several sources. Please refer to Cost and benefit category descriptions and calculations section for sources.

Figure 10: Money Flow in Electronics Recycling System

7.6 Cost and Benefit Category Descriptions and Calculations

This section reviews each item included in the cost and benefit analysis providing a description of each category. If a monetized value was estimated for the category, an explanation of how the monetized value was estimated is provided.

7.6.1 Costs of Electronics Stewardship Program

7.6.1.1 Program Delivery Costs

The Alberta Recycling Management Authority (ARMA) is responsible for managing Alberta's electronics recycling program through its Electronics Recycling Alberta (ERA) division.

Regulation authorizes ARMA to levy and collect an advance disposal surcharge (ADS) fee which can be used to:

- Establish and administer waste minimization and recycling programs;
- Education and promotion programs to support waste minimization and recycling;
- Expenditures on the collection, transportation, storage, processing and disposal of designated materials; and
- Research and development activities related to designated materials management.

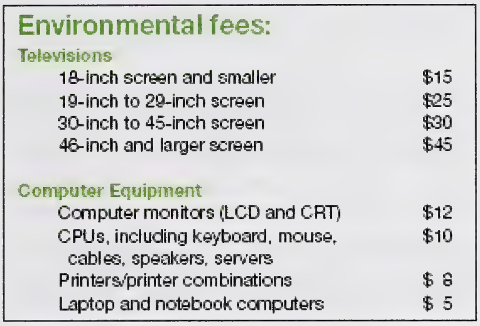
While ERA oversees and facilitates electronics recycling in the province, it is also responsible for promoting public education and awareness and investing in electronics recycling technology.

Specific goals of ERA include:

- Enable waste minimization and recycling solutions for all eligible electronics discarded by Albertans.
- Eligible electronics are recycled in an environmentally and socially responsible manner.
- Electronics recycling is economically viable.
- Albertans are aware of and support electronics recycling.
- The list of eligible electronics is reviewed at least annually, consistent with the Regulation.

Monies to deliver the electronics recycling program are generated through an advanced disposal surcharge (ADS) paid at the point of sale on all eligible electronics. Surcharges range from $5 to $45 depending on the product. Figure 11 reviews the ADS fees paid per product classification.

Figure 11: ADS / Environmental Fees (by Product Classification)



Environmental fees:

Televisions

18-inch screen and smaller	$15
19-inch to 29-inch screen	$25
30-inch to 45-inch screen	$30
46-inch and larger screen	$45

Computer Equipment

Computer monitors (LCD and CRT)	$12
CPUs, including keyboard, mouse, cables, speakers, servers	$10
Printers/printer combinations	$ 8
Laptop and notebook computers	$ 5

Source: ARMA, 2006.

In the 2005-06 fiscal year, ERA generated $23.5 million in revenues through the collection of ADS fees. This includes $10,500 earned in surcharge interest. ADS fees were paid on the purchase of approximately 1.76 million electronic products. Table 98 breaks down revenue generated through the collection of ADS fees by designated product.

Table 98: ADS Revenue by Designated Product

	ADS Fees	Total Purchased	2005-06 fiscal year
Advance Disposal Surcharges			
TV 18" screen and smaller	$15	83,398	$1,250,970
TV 19"-29" screen	$25	201,365	$5,034,125
TV 30"-45" screen	$30	78,446	$2,353,380
TV 46" screen and larger	$45	45,441	$2,044,845
CPUs	$10	356,366	$3,563,660
Printer/printer combos	$8	371,158	$2,969,264
Laptops/electronic notebooks	$5	192,270	$961,350
Computer monitors	$12	411,791	$4,941,492
Other	$18.75*	17,541**	$328,889
Subtotal		**1,757,776**	**$23,447,975**
Surcharge Interest			**$10,589**
TOTAL RECYCLING REVENUES			**$23,458,564**

*Estimated based on average of ADS fees.
** Estimated based on revenue collected divided by the average ADS fee.

Source: ERA, 2006.

It is important to recognize that the product mix of electronics purchased will not necessarily reflect the product mix of electronics recycled given the lifespan of electronic products. In a sense the ADS collected on products today can be thought of as a trust that will allow these products to be recycled at the end of their life. It should also be noted that it is difficult to forecast ADS revenue and product mix as electronic sales reflects economic conditions, consumer interests, as well as technological advancement, all of which are not easily predicted.

7.6.1.1.1 Electronics Recycling Alberta Program Expenditures

Total expenditures to provide electronics recycling in Alberta for the 2005-06 fiscal year totaled over $7 million. Table 99 reviews expenditures by category. The single largest area of expenditures was for recycling incentive programs totaling $4.8 million. This refers to money spent which facilitated the collection, transportation, and processing of electronics. For example, collection agents (municipalities, depots) are compensated up to $50/tonne to collect and temporarily store designated used electronic goods (Schultz, 2006).

Table 99: Program Expenditures

Expenditures	**2005-06 Fiscal Year**	**% Total Expenditure***
Surcharge Compliance Program Delivery	***$691,022***	**10%**
Recycling Incentive Programs		
Collections	$123,260	2%
Transportation and handling	$316,569	4%
Processing	$3,190,259	45%
Recycling program delivery	$1,121,523	16%
Incentive Expenditures	***$4,751,611***	**67%**
Administration		
Salaries, fees, and related	$274,955	4%
General administration expenses	$203,839	3%
Amortization	$41,324	1%
Financial audit	$25,145	0%
Operation Expenditures	***$545,263***	**8%**
Fund Investment	**$95,405**	**1%**
Recycling Development		
Research and development	$0	0%
Public information	$1,036,608	15%
Collection development	$0	0%
Recycling development	$0	0%
Professional fees	$0	0%
Total Recycling Development	**$1,036,608**	**15%**
TOTAL EXPENDITURES	**$7,119,909**	**100%**

*Totals do not add due to rounding

Source: ERA, 2006a.

In terms of percentage of overall expenditures, recycling program incentives accounted for 67% of the total expenditures followed by recycling development (15%), ADS program delivery (10%), administration (8%) and fund investment (1%).

During the first full fiscal year of operation providing a formal electronics recycling program in Alberta came with a total expenditure cost of $7.1 million. This investment resulted in 247,000 electronic products being recycled. Table 100 provides a break down of recycled products by category.

Table 100: Electronic Products Recycled by Category

Designated Electronic Products	Total Recycled	Percentage
TV 18" screen and smaller		5%
TV 19"-29" screen	21,414	
TV 30"-45" screen	4,486	2%
	628	0%
CPUs	77,150	31%
Printer/printer combos		17%
Laptops/electronic notebooks	1,993	
Computer monitors	86,117	35%
	246,973	**100%**

Source: ERA, 2006.

Computer monitors and CPUs were the top two categories of electronic products recovered for recycling representing 35% and 31% respectively of the total products recycled.

The recovery of 247,000 electronic products for recycling translates into 4,160 tonnes of material recycled. From a program cost perspective this equals a cost of $1,650/tonne of material recycled.

It is important to recognize, however, that the total and per tonne expenditure costs reflect the infancy of the program. For example many of the expenditure costs related to program operation reflect initial investment costs to set up a delivery infrastructure. Notable examples include set up costs related to the collection of the ADS including the integration of retailers and streamlining the collection process. In addition there will be economies of scale savings as recovery rates increase with program maturity.

- ***Program operations costs: $7,119,909***
- ***Per tonne equivalent costs: $1,654***

7.6.1.2 Supplier Support Costs

While suppliers (manufacturers, distributors and retailers) do not directly support the program financially, they do support the program indirectly by remitting the ADS to ARMA. Suppliers are required to collect the ADS fee at the point of sale on designated materials and remit the levy to ERA. As a result, retailers incur an administration cost for which they are not compensated. It is difficult to determine the extent of these costs to suppliers. It is important to note, however, that all suppliers which directly sell products to consumers are required to collect and remit the ADS. Over 1,600 suppliers are registered in the province (ARMA, 2006a). According to ARMA, they are not aware of any retailers adding more staff time to handle the increased bookkeeping responsibility (ARMA, 2005). As a result, it is assumed that actual supplier costs are low enough to be immaterial to the analysis.

- ***Supplier support costs: Not estimated***
- ***Per capita equivalent costs: Not estimated***

7.6.1.3 Government Support Costs

The electronics recycling program is operated by ARMA, a delegated administrative organization (DAO), which operates at an arms length from the government for transparency purposes. ARMA has, however, received government support to develop and launch the program.

Based on estimates provided by Alberta Environment (2005), pre-program development and launch costs before the 05-06 fiscal year totaled $120,000 in staffing time. If we distribute this amount over the length of program operation (18 months – October 2004 to March 31, 2006), it equals $80,000 per year.

Direct government support during the 05-06 fiscal year was estimated to be over $23,000. This includes the combined time allocated by program staff, managers, and the assistant deputy minister. Due to the infancy of the program, government support during this initial start-up period is higher than the typical on going government support of the other stewardship programs.

- ***Government support costs: $103,142***
- ***Per tonne equivalent costs: $24***

7.6.1.4 Consumer Costs

The consumer of electronic goods pays the ADS fee at the point of sale. As noted above, the ADS fee is the direct source of revenue supporting electronics recycling in Alberta.

The increased cost burden to consumers on the purchase of 1.76 million electronic products covered under the program totaled over 23 million dollars. See Table 98 (above) for the total ADS paid by consumers by product classification.

- ***Consumer costs (ADS): $23,447,975***

7.6.1.4.1 Electronics Drop-Off

The program places responsibility on consumers to drop off used electronic goods at designated locations. There are over 100 permanent drop-off sites in Alberta. In addition, several smaller communities hold electronic drop-off events. These will be coordinated in conjunction with HHW drop events in the upcoming year. The designated trips to drop off used electronic goods comes with a time and transportation cost to consumers. Previous to the program electronic goods were disposed of in the regular waste system.

Due to the infancy of the program, there is no data (participation rate, number of drop offs per year, average distance traveled to drop-off sites) to indicate the extent of these costs to households. In addition, more and more drop-off sites are being added to the program dramatically increasing program accessibility. This is especially notable in rural regions where in many communities regular drop-off sites are just being introduced.

In theory, participation is mandatory in some communities as designated electronic materials will no longer be accepted in the regular waste stream. In these communities, such as the City of Edmonton, households trying to dispose of electronic materials at the curbside will not have their garbage removed and will be notified of the proper disposal method.

Given the infancy of the program, the time and transportation costs borne by consumers are not estimated. The impact of these costs, however, is not likely to be significant compared to other costs within the program. As the program matures, and collection networks are further established, additional research can be conducted to establish the relative value of consumer participation.

7.6.1.5 Disruption in Marketplace

Electronics recycling in Alberta operates on a level playing field. This is attributed to the fact that program delivery is consistent throughout the province and that the ADS fees are collected without exception at the point of sale on all designated products. Collection and processing incentives are also standardized throughout the province. Further, ERA funds recyclers based on the material successfully recycled. They are not compensated for residual material that is sent to landfill. Lastly, there are no loans, loan guarantees, start up grants or bail outs for processors or entities wishing to enter the marketplace (ARMA, 2006a).

While the regulations provide a level playing field, the conditions to qualify for processor permits may restrict entry into the marketplace. The costs to meet permits standards may be a barrier for smaller players and those without guaranteed financial backing. In addition, ERA mandates that all electronics must be recycled in an environmentally and socially responsible way potentially preventing access to more lucrative economic markets.

Previous to the program, the vast majority of electronics were landfilled. There was, however, a small electronics recycling industry which may have been negatively disrupted by the introduction of a formal electronics program. Processors in the province increased from 1 previous to the program to a total of 6 now that the program is in place. While the pre-existing processor ceased operation shortly after the program started, industry sources suggest that it was due to reasons independent of the increase in processors. In theory, the introduction of a formal program should have benefited the pre-existing processor, given the increase in supply of products entering the electronics recycling marketplace and the incentive program compensating processors.

- ***Disruption in marketplace costs: Not estimated***

7.6.1.6 Processing Costs

7.6.1.6.1 GHG Emissions – Processing and Manufacturing

While there are GHG emissions associated with processing recovered electronics, electronic recycling generates an overall greenhouse gas savings. This analysis does not break out GHG costs and benefits by component but uses the summary level findings from the ICF Consulting report prepared for Environment Canada and NRCan (2005). Savings estimates are discussed further in the GHG emissions benefit component below.

7.6.1.6.2 GHG emissions – Transportation

Again, this report relies on an overall estimate of GHG savings that are achieved by recycling electronics as opposed to sending them to landfill (addressed below). It is important, however, to highlight facets of the program where GHG emission costs occur. For example there are the increased GHG costs from transporting used electronics from consumers to drop-off points and the increased transportation related GHG costs to transfer electronic products from drop-off points to processing facilities and to ship processed materials to commodity markets.

7.6.1.6.3 Other Environmental Impacts – Transportation/Processing

There are other environmental impacts associated with transporting and processing used electronic goods that need to be acknowledged, most notably the release of air pollutants and water use. Similar to greenhouse gas emissions, however, we address these impacts as part of the overall environmental impacts provided by recycling electronics. As noted below recycling electronics provides an overall benefit offsetting the increased environmental impacts from transportation and processing.

7.6.2 Benefits – Electronics Recycling

Over 4,100 tonnes of electronics waste was collected for recycling in the first fiscal year of the program. Table 101 reviews the number of products by category recycled and the equivalent total tonnage of material recycled by product.

Table 101: E-waste Recycled (Units and Total Tonnage)

	Units	Kg/unit	
Televisions < 18"	13,229	13	172
Televisions 19" – 29"	21,414	50	1,071
Televisions 30" – 45"	4,486	57	256
Televisions > 46"	628	100	63
Monitors	86,117	14	1,171
Computers	77,150	14	1,049
Laptops / Notebooks	1,993	5	9
Printers	41,956	9	369
Total	**246,973**	**261**	**4,160**

Source: ARMA, 2006.

It is important to recognize that the electronics collected over this initial period are expected to increase as the program matures. ARMA estimates that the collection of e-waste will increase by 15% next year alone (ARMA 2005, Business Plan).

It is unclear how much electronic equipment was recycled In Alberta previous to the program. There was one official processor who accepted used electronics (primarily computer equipment) for a small fee but the scope and volume of their operation is unknown. It is also assumed that some informal reuse, recovery, and recycling took place.

A baseline study entitled, 'End-of-Life Electrical and Electronic Equipment in Canada', prepared for Environment Canada (RIS, 2003) estimated national recycling rates of 3% for televisions, 11% for computers, and 5% for printers in 1999. Assuming that 10% of national numbers are attributable to Alberta would suggest that, at most, 1,670 tonnes of e-waste were recycled prior to the program. Table 102 presents pre-program estimates of electronic material recycled by product category based on national e-waste recycling rates published in the 'End-of-Life Electrical and Electronic Equipment in Canada' baseline study (RIS, 2003).

Table 102: Electronic Products Recycled Pre-Program (tonnes)

	Total (tonnes)
Computers	330
Laptops	30
Monitors	470
Printers	170
Televisions	670
Total	**1,670**

Sources: RIS, 2003; RIS, 2003a.

7.6.2.1 Greenhouse Gas Reductions Benefit

To quantify the GHG reduction of increased electronics recycling this report uses the ICF Consulting conversion factors prepared for Environment Canada and NRCan (2005). In this case, the conversion factors per tonne of material recycled as opposed to being landfilled are as follows:

- Personal computers > GHG benefit of (1.61) tonnes of eCO_2
- Televisions > GHG benefit of (0.24) tonnes of eCO_2
- VCRs > GHG benefit of (0.95) tonnes of eCO_2

The ICF numbers account for the full lifecycle of products, including raw material extraction, manufacturing, distribution, collection, processing and transportation.

Making the assumption that the greenhouse gas benefit of recycling printers is equivalent to that of VCRs, and applying these values to the weight of materials collected results in a net reduction in greenhouse gas emissions of approximately 4,315 tonnes of eCO_2 for materials collected in the first fiscal year of the program. Table 103 reviews the GHG reduction by product category gained by recycling these electronic products as opposed to landfilling them.

Table 103: GHG Reduction by Product Category

	Units	Total (tonnes)	factor	GHG reductions (tonnes eCO_2)
Televisions < 18"	13,229	172	(0.24)	41
Televisions 19" – 29"	21,414	1,071	(0.24)	257
Televisions 30" – 45"	4,486	256	(0.24)	61
Televisions > 46"	628	63	(0.24)	15
Monitors	86,117	1,171	(1.61)	1,886
Computers	77,150	1,049	(1.61)	1,689
Laptops / Notebooks	1,993	9	(1.61)	14
Printers	41,956	369	(0.95)	351
Total	**246,973**	**4,160**		**4,315**

Sources: ERA, 2006; ICF Consulting, 2005.

This report estimates a high end per tonne eCO_2 value based on the social cost of carbon used in Britain's Stern Review on the Economics of Climate Change (2006). The review calculates the damage done over time by a tonne of CO_2 emitted this year, if the world continues on a business-as-usual (BAU) scenario. The social cost of carbon under the BAU is estimated at US\$85/tCO_2 (2000\$) now, and rising over time. We converted the current value as C\$142/tCO_2 (2005\$). It is important to note that the Stern Review is based on the latest science, which predicts greater increases in global average temperature (at least 5 degrees Celsius, compared with previous estimates of 2-3 degrees Celsius).

As a low end per tonne eCO_2 value we use the European carbon trading market value which we estimate at C\$7.48/tC (4.37 Euros/tC) based on April 4, 2006 trading values. This translates to C\$27/tCO_2. We recognize that the true value may very well fall in between these limits and therefore as a middle value estimate selected the mid point between the Stern Review cost of carbon value and the European carbon trading market value. The proposed middle estimate is \$85/tonne eCO_2.

Table 104 highlights possible greenhouse gas reduction benefit values based on the established per tonne eCO_2 range estimates being used for this report. GHG reduction benefits in the 05-06 fiscal year range from \$118,000 to \$611,000. The per tonne material recycled savings range from \$28/tonne to \$147/tonne.

Table 104: Greenhouse Gas Reduction Benefits ($ Range Low, Medium, High)

Estimated GHG \$ reduction benefits	**Low estimate (\$27/ tonne CO_2)**	**Medium estimate (\$85/ tonne CO_2)**	**High estimate (\$142/ tonne CO_2)**
Benefit 05-06 fiscal year	\$118,000	\$365,000	\$611,000
Benefit per tonne recycled	\$28	\$88	\$147

Reduction in greenhouse gas emissions benefit:

- ***Greenhouse gas savings 05-06 fiscal year: \$118,000 – \$611,000***
- ***Savings per tonne recycled 05-06 fiscal year: \$28 – \$147***

7.6.2.2 Extended Landfill Life

7.6.2.2.1 Disposal Costs

In assessing a reasonable value for landfill cost, it could be argued that landfills operated by the private sector are profit driven and may better reflect actual costs. Essentially, the operations of a private-sector company are bound to be profitable by the expectations of its shareholders. Therefore, private landfill operators must account for all direct and potential costs associated with their operations. It is reasonable, then, to suggest that the rates charged by private landfills are a good proxy of the full costs, excepting those costs borne by society as a whole.

Discussions with Waste Management Inc., have concluded that the average gate rate at a private landfill is approximately \$42/tonne (Hantiuk, 2006).

An average of landfill tipping fees across Alberta as reported to Alberta Environment in 2005 was \$37/tonne. This suggests a similar range to the private sector costs above.

It is often asserted by waste reduction advocates that the costs of landfill disposal are generally underestimated, and that the full costs of operating a landfill are not reflected in the tipping fee. By not accounting for the full costs of landfill disposal, alternative measure such as recycling and composting are placed at an economic disadvantage.

In many cases, only direct capital and operating costs are taken into account when determining landfill costs. It is recognized that indirect costs, including health risks, property value depreciation, environmental risks, lost opportunity and quality of life must also be taken into account (AOW, 1995).

The $42/tonne disposal estimate for private landfills does not include costs borne by society in general, potentially neglected future siting costs, unanticipated closure and post closure costs, nor the nuisance costs and potential loss of property value costs borne by neighbouring residents and potential future environmental pollution risks.

A University of Toronto Department of Economics report on municipal user fees suggested that the net marginal social costs for landfill disposal were in excess of $50/tonne in the Toronto region, while as low as $30/tonne in other regions of Canada (Dewees, 2002). Adding these social costs would suggest a full valuation of landfill at $72-$92/tonne.

Compacted garbage has a density of 1,200-1,500 pounds/yd^3 (CSR, 2003). Based on this, one tonne of garbage takes up 1.5-1.8 yd^3. Therefore, a landfill cost of $72/tonne would translate into approximately $40-$48/yd^3, whereas $92/tonne would equate to $51-$61/yd^3.

Therefore we estimate a landfill disposal cost range of:

- Low: $40/yd^3
- Medium: $50/yd^3
- High: $61/yd^3

Discussions with electronics processors have indicated that the average density of electronics packed for shipment translates into a space consumption of approximately 8.5 yd^3/tonne. Assuming that landfill compaction would compress electronics by 50%, a tonne of electronics would consume approximately 4.25 yd^3 of landfill space.

Using this volume ratio, the total 4,160 tonnes of electronics recycled in the first fiscal year would represent a landfill savings of over 17,000 yd^3.

Therefore, recycling 4,160 tonnes of electronics provides an extended landfill savings of between $707,000 and $1,078,000. Table 105 provides low, medium, and high savings estimates and an estimate of the savings per tonne recycled.

Table 105: Extended Landfill Savings

	Savings Cubic yards	**Low estimate ($40/yd^3)**	**Medium estimate ($50/yd^3)**	**High estimate ($61/yd^3)**
2005-06 fiscal year	17,680	$707,000	$884,000	$1,078,000
Per tonne recycled		$170	$213	$259

Sources: ERA, 2006; Hantiuk, 2006.

- ***Extended landfill life benefit 05-06 fiscal year: $707,000 – $1.078,000***
- ***Benefit per tonne recycled 05-06 fiscal year: $170 – $259***

7.6.2.2.2 Avoided Siting Costs

The above extended landfill life values have factored in avoided siting costs. To demonstrate the significance of siting costs we have separated this component out. The following list overviews siting costs examples referenced in the GPI Atlantic cost benefit analysis of the Nova Scotia solid waste system (2004).

- Regional District of Kootenay, BC – $3-$4 million
- Ontario Municipalities (research and siting costs) – $2.16/tonne (2000$);
- Halton, Ontario – $2/tonne (1996$);
- Landfills serving large municipalities – $1.43-$1.58/tonne (1996$)
- Otter Lake facility serving Halifax Regional Municipality – $0.55/tonne (2000$)

The values referenced in the GPI Atlantic report (2004) give an avoided siting cost range of $0.55/tonne to $2.16/tonne (2000$). Updating these values to 2004$ using the consumer price index gives a range of $0.60/tonne to $2.37/tonne.[26]

Table 106: Avoided Siting Costs

	Savings (Cubic yards)	Low estimate ($0.60/tonne)	High estimate ($2.37/tonne)
2005-06 fiscal year	17,680	$10,608	$41,902

Sources: GPI Atlantic, 2004; ERA, 2006.

As indicated in Table 106, the savings by delaying the potential siting costs of a new landfill range from $11,000 to $42,000 dollars. These estimates are included as part of the extended landfill life savings but are noted here to demonstrate the significant costs involved in simply locating new landfill sites.

7.6.2.3 Energy Savings

There are substantial energy savings gained by using recycled materials from recovered electronic products. The bulk of the energy savings are largely a result of recycled materials offsetting the need for virgin material use. In addition, life cycle analysis studies suggest that using recycled feedstocks as opposed to virgin materials also consume less energy in processing and in transport throughout their lifecycles (PHA Consulting, 2006).

A study by PHA Consulting (2006) entitled 'Electronic Waste Recovery Study' prepared for the Nova Scotia Resource Recovery Fund Board presents the following energy savings gained by using recycled metals common in electronic products as opposed to virgin metal feedstocks.

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[26] The consumer price index between 2000 and 2004 increased by 9.8% (Statistics Canada, 2006).

Energy savings:

Aluminum	95% less
Copper	85% less
Steel	74% less
Lead	65% less
Zinc	60% less

Applying the energy saving conversion factors referenced by PHA Consulting (2006) suggests that recycling electronics in Alberta for the 2005-06 fiscal year yielded an energy savings of 313 million megajoules or 53,000 barrels of oil equivalent.

Table 107: Energy Savings (Relative to Energy Required for Virgin Production)

	Tonnes recovered	Megajoules saved	Barrels of oil equiv. saved	Dollar savings ($60.63 per barrel)
Aluminum	320	132,127,491	22,361	$1,355,757
Copper	228	33,876,934	5,733	$347,610
Ferrous	737	34,741,100	5,880	$356,478
other metals	263	13,564,207	2,296	$139,182
Glass	1,451	5,676,852	961	$58,250
Plastics	1,072.28	92,586,399	15,669	$950,027
Total	**4,071**	**312,572,983**	**52,900**	**$3,207,303**

PHA Consulting, 2006.

Offsetting the need for 53,000 barrels of oil translates into a savings of $3.2 million (Bloomberg, 2006; Bank of Canada, 2006)[27]. This estimate is based on the average price of a barrel of oil in 2005 of $60.63.

- ***Energy savings benefit 05-06 fiscal year: $3,207,000***
- ***Benefit per tonne recycled 05-06 fiscal year: $771***

7.6.2.4 Environmental and Human Health Liability

Many electronic products especially computers and other IT equipment contain hazardous materials which can be dangerous to both the environment and human health if not properly disposed of. For example, printed circuit boards contain heavy metals such as antimony, silver, chromium, zinc, lead, tin and copper. The lead oxide used in the cathode ray tubes (CRT) of computer monitors is of particular concern because it is in a soluble form. It is estimated that 1,356 tonnes of lead was contained in the PCs and monitors disposed in 1999 in Canada (Environment Canada, 2001). This equipment also contained approximately 2.0 tonnes of cadmium and 0.5 tonnes of mercury. Based on the forecasted estimate that 47,821 tonnes of PCs and monitors will be disposed in 2005 and assuming that the average composition of this equipment will not change significantly by that year, **the weight of lead, cadmium and mercury that will be disposed with this stream in 2005 will increase to 3,012 tonnes, 4.5 tonnes and 1.1 tonnes respectively** (Environment Canada, 2001).

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[27] The average price of a barrel of oil in 2005 was 50.04 USD. We converted this into Canadian dollars using the average exchange rate for 2005 of 1.2116.

Two hazardous materials widely present in electronic equipment are copper and lead. We estimate the amount of copper and lead recovered in the Alberta waste stream based on material composition data presented in ICF report (2005). Table 108 reviews the material composition of PCs & monitors, televisions and VCRs.

Table 108: Percent Material Composition of Select Electronic Devices

Material	PCs & Monitors	Televisions	VCRs
Copper	6.9%	2.1%	11.0%
Lead	6.3%	4.7%	0.0%
CRT (Cathod ray tube) Glass	24.8%	54.8%	0.0%
ABS (acrylonitrile-butadiene-styrene) resin	11.5%	15.2%	11.5%
PPO/HIPS (polyphenylene oxide/ high impact polystyrene) resin	11.5%	15.2%	11.5%
Aluminum	14.2%	0.2%	0.0%
Steel Sheet	20.5%	7.3%	45.0%
Zinc	2.2%	0.0%	0.0%
Other	2.2%	0.0%	0.0%

Source: ICF 2005, Exhibit 7.1.

Applying the ICF (2005) composition values to the volumes of material collected in Alberta suggests that approximately 227 tonnes of copper and 214 tonnes of lead were recovered for recycling in the 2005-06 fiscal year.

Table 109 summarizes the amount of selected hazardous materials recovered as a result of the electronics stewardship.

Table 109: Hazardous Materials Diverted From Regular Waste Stream (tonnes)

	Copper	Lead	Cadmium	
Recycled	227.23	213.83	0.17	0.04

Another hazardous material present in computers of increasing concern not listed in Table 108 is beryllium metal. Unfortunately there is little data detailing the toxicity of Beryllium metal. It was, however, widely used in motherboards of older personal computers (products likely at their end of life) and is currently used in combination with copper as an alloy in current computer models (Five Winds International, 2001).

Even in its infancy, the electronics program has led to substantial amounts of hazardous materials being recovered. While there are recycling commodity markets for these materials providing a financial benefit to their recovery, the real societal benefit is not the resale value of these materials but the avoided environmental contamination and human health liability. It is important to note, that recovering and recycling electronics does not necessarily eliminate exposure to hazardous materials or the release of hazardous materials into the environment. In fact, during some recycling processes adverse impacts may even be increased. An example referenced in the Five Winds International (2001) electronics toxicity is the formation of dioxins and furans when plastics containing bromine- or chlorine compounds are heated for recycling.

7.6.2.5 Net Marginal Benefits of Resource Recovery

In the first year of the electronics recycling program the recovery and recycling of used electronic products increased by 250% from 1,670 tonnes recycled to 4,160 tonnes recycled. The net marginal monetary benefit of this increase in electronics recycling from a resource recovery perspective is over $2.6 million dollars. Table 110 reviews the net marginal benefits by category monetized in this report.

Table 110: Net Marginal Resource Recovery Benefits of Electronics Recycling

Marginal savings	Low estimate	Medium estimate	
GHG reduction	$70,800	$219,000	$366,600
Extended landfill	$424,200	$530,400	$646,800
Energy savings	$1,924,380	$1,924,380	$1,924,380
Total	**$2,419,380**	**$2,673,780**	**$2,937,780**

Sources: This summary table draws on several sources. See specific sources in respective sections above.

7.6.2.6 Direct Employment

For the 2004/2005 fiscal, ARMA estimates that 145 jobs are supported by the electronics recycling program (Schultz, 2006). This includes employment at ARMA in which some employees have an overlap of responsibility between the electronics recycling program and the tire recycling program.

It is not known if the jobs generated by the electronics recycling program have led to a reduction in unemployment in the province. From a full cost benefit perspective it is important to distinguish between new jobs and a transfer of workers from one sector of the economy to another. This is a stronger likelihood in regions of low unemployment. The new jobs may also have come at the expense of potential jobs in other sectors of the economy if the increased expenditure on waste management meant that there was less expenditure in other economic sectors (European Commission, 2001).
A study sponsored by the Directorate-General Environment of the European Commission (2001) concluded that waste management measures are likely to have only a small effect, either positive or negative, on employment. The conclusion challenges the common perception that recycling and other waste management activities stimulate new employment (especially for the socially excluded or the low skilled).

Levels of unemployment in Alberta are at an all-time low. The average unemployment rate in 2004 was 4.6%. Given the lack of workers seeking employment in the province, it is difficult to know if the jobs associated with the electronics stewardship program facilitated employment leading to a decrease in people looking for work.

A conservative estimate of the benefit of employment is to adjust the total employment potential by the unemployment rate to account for job growth that would not otherwise be filled in the economy. In this case we adjust the total direct employment potential by the Alberta unemployment rate of 4.6%. What is not understood for Alberta is what percentage of these jobs were filled by an in-migration of workers. An influx of workers suggests that these jobs were potentially filled by people seeking work. Between the years 2000 and 2005, there was a net increase in inter-provincial migration of 110,000 people to Alberta from other provinces. To account for jobs being filled by an influx of workers we derived a medium and high estimate of the contribution of employment by adjusting the total employment potential by the Canadian average unemployment rate and the unemployment in Newfoundland and Labrador, the province with the highest unemployment rate. The unemployment rates for Canada and Newfoundland and Labrador in 2004 were 7.2% and 15.7% respectively.

Jobs supported by the Electronics Recycling Program – 145

Seasonally Adjusted Average Weekly Earnings:
Administrative and support, waste management and remediation services
August 2005 (Statistics Canada, 2005): Alberta – $653.10 per week / $33, 961 per year.

Direct employment $145 x $33,961 = $4,924,345

Table 111: Direct Employment Impacts of Electronics Program

	Low estimate	Medium estimate	High estimate
Direct employment potential	$4,924,345	$4,924,345	$4,924,345
Unemployment rate	4.60%	7.20%	15.70%
Direct employment benefit	$227,000	$355,000	$773,000

- ***Direct employment benefit supported by the electronics materials recycling stewardship program: $227,000 – $773,000***
- ***Direct employment benefit per tonne of material recycled: $54 – $186***

7.6.2.7 Indirect Employment

If direct employment increases, there is a 'multiplier effect' as those newly employed people spend their salaries on goods and services. This stimulates economic activity and can create additional employment in the sectors supplying those goods and services.

A study by R. Beck in 2001 estimated that every job in the recycling industry generates 1.3 spin-off jobs. This estimate has been referenced in other cost benefit analysis including the GPI Atlantic Nova Scotia Solid Waste Resource accounts (2004) which used Beck's estimate as a proxy to determine the benefits of indirect employment and economic spin-off.

There is some evidence to suggest, however, that indirect job estimates of 1.3 per direct job may be high. Similar to the conclusion for direct employment, the Directorate-General Environment of the European Commission study found that the indirect impact and induced impacts of employment are likely minimal given that increased expenditure on waste management often detracts from expenditures in other economic sectors resulting in lost jobs in those sectors. This is known as a 'crowding-out' effect (2001).

The number of indirect jobs supported by the Electronics Recycling Program if we use the 1.3 indirect jobs per direct job ratio is 145 x 1.3 = 188.5.

Average Weekly Earnings:
Sales and Services Occupations: November 2005 (Statistics Canada, 2006a):
Alberta – $538.40 per week / $27,997 per year.

Indirect employment $ – 188.5 x $27,997 = 5,277,435

Table 112: Indirect Employment Impacts of Electronics Program

	Low estimate	Medium estimate	High estimate
Indirect employment potential	$5,277,435	$5,277,435	$5,277,435
Unemployment rate	4.60%	7.20%	15.70%
Indirect employment benefit	$243,000	$380,000	$829,000

- ***Indirect employment benefit supported by the electronics recycling stewardship program: $243,000 – $829,000***
- ***Indirect employment benefit per tonne of material recycled: $58 – $199***

7.6.2.8 Community Image / Civic Pride

While it is difficult to measure the impact of the electronics recycling program on community image and civic pride there is widespread opinion that Albertan's take pride in being the first province in the country to begin electronics recycling. Alberta's leadership reflects more generally the fact that Alberta is a national leader in recycling suggesting that the program contributes positively to the community image.

7.6.2.9 Environmental Stewardship

The more tangible natural capital benefits of the electronics recycling program are captured in such categories as energy savings, reduced GHG emissions, and reduced environment and human health liability. While more difficult to measure, the electronics recycling program provides an indirect benefit by helping to foster an environmental consciousness or ethic based on the principles of resource conservation and environmental protection.

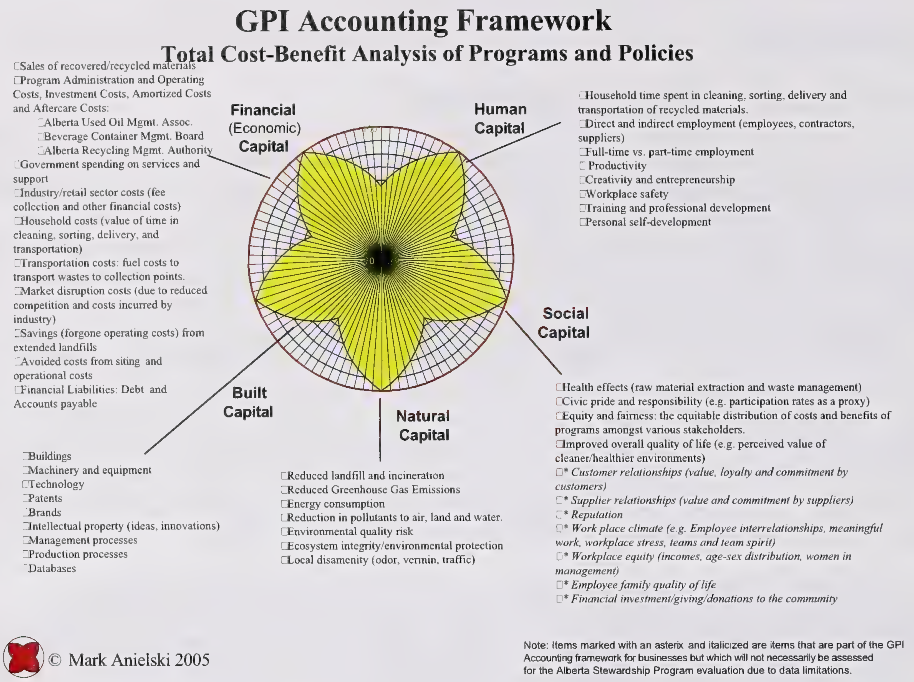
Appendices

Appendix A: GPI Accounting Model

The GPI was originally developed in the United States by the economic think-tank Redefining Progress to measure whether a country's or community's economic growth is in fact resulting in a net improvement in welfare (or well-being). The GPI, which originates from green economics and welfare economics, and was originally developed as an alternative measure of economic welfare replacing the gross domestic product (GDP), the current metric of economic growth. Unlike GDP, the GPI is intended to more reliably distinguish uneconomic growth by accounting for those environmental and social costs and benefits which the GDP currently either ignores or treats social costs and environmental clean up costs as a contribution to economic welfare, rather than a depreciation of social and natural capital. The GDP vs. the GPI is analogous to the difference between the Gross Profit of a company and the Net Profit; the Net Profit is what determines the long-term health of the company. In other words, the GPI attempts to provide a more honest full cost and benefit accounting of economic growth or a public policy or program than simply measuring gross profits or revenues.

Conventional cost-benefit analysis has been used for assessing the potential net marginal benefit (cost) of public policies and economic development opportunities. These cost-benefit analysis typically consider only those benefits and costs that can be expressed in monetary terms in the determination of whether a project, policy or program is contributing to the overall welfare (utility) or well-being of citizens. Similarly, from a national or provincial income accounting perspective, measures like the GDP fail to account for the full social and environmental costs and benefits associated with economic progress and thus give a false measure of economic welfare.

Conversely, the GPI accounting model is a tool for assessing both the monetary and non-monetary impacts to the economic, social and environmental well-being of government policies, programs and economic development, in general. (see Figure 12, which provides an example of the GPI model applied to Alberta's waste stewardship program analysis). The GPI accounting model uses an integrated five-capitals accounting framework to account for both the physical, qualitative and monetary conditions of human, social, natural, built and financial (or economic) capital for evaluating the long-term sustainability of policies, programs or economic progress. Using a taxonomy of theses costs and benefits, a GPI (Genuine Progress Index) can be derived that reveals the full range of both tangible and intangible benefits and costs which may or may not be accounted for in conventional financial statements or aggregate measures of economic progress, like the GDP (Gross Domestic Product).


GPI Accounting Framework
Total Cost-Benefit Analysis of Programs and Policies
Financial (Economic) Capital
Sales of recovered/recycled materials
Program Administration and Operating Costs, Investment Costs, Amortized Costs and Aftercare Costs:
Alberta Used Oil Mgmt. Assoc.
Beverage Container Mgmt. Board
Alberta Recycling Mgmt. Authority
Government spending on services and support
Industry/retail sector costs (fee collection and other financial costs)
Household costs (value of time in cleaning, sorting, delivery, and transportation)
Transportation costs: fuel costs to transport wastes to collection points.
Market disruption costs (due to reduced competition and costs incurred by industry)
Savings (forgone operating costs) from extended landfills
Avoided costs from siting and operational costs
Financial Liabilities: Debt and Accounts payable
Human Capital
Household time spent in cleaning, sorting, delivery and transportation of recycled materials.
Direct and indirect employment (employees, contractors, suppliers)
Full-time vs. part-time employment
Productivity
Creativity and entrepreneurship
Workplace safety
Training and professional development
Personal self-development
Social Capital
Health effects (raw material extraction and waste management)
Civic pride and responsibility (e.g. participation rates as a proxy)
Equity and fairness: the equitable distribution of costs and benefits of programs amongst various stakeholders.
Improved overall quality of life (e.g. perceived value of cleaner/healthier environments)
* *Customer relationships (value, loyalty and commitment by customers)*
* *Supplier relationships (value and commitment by suppliers)*
* *Reputation*
* *Work place climate (e.g. Employee interrelationships, meaningful work, workplace stress, teams and team spirit)*
* *Workplace equity (incomes, age-sex distribution, women in management)*
* *Employee family quality of life*
* *Financial investment/giving/donations to the community*
Natural Capital
Reduced landfill and incineration
Reduced Greenhouse Gas Emissions
Energy consumption
Reduction in pollutants to air, land and water.
Environmental quality risk
Ecosystem integrity/environmental protection
Local disamenity (odor, vermin, traffic)
Built Capital
Buildings
Machinery and equipment
Technology
Patents
Brands
Intellectual property (ideas, innovations)
Management processes
Production processes
Databases

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Note: Items marked with an asterix and italicized are items that are part of the GPI Accounting framework for businesses but which will not necessarily be assessed for the Alberta Stewardship Program evaluation due to data limitations.

Figure 12: GPI Accounting Model for Stewardship Program Analysis

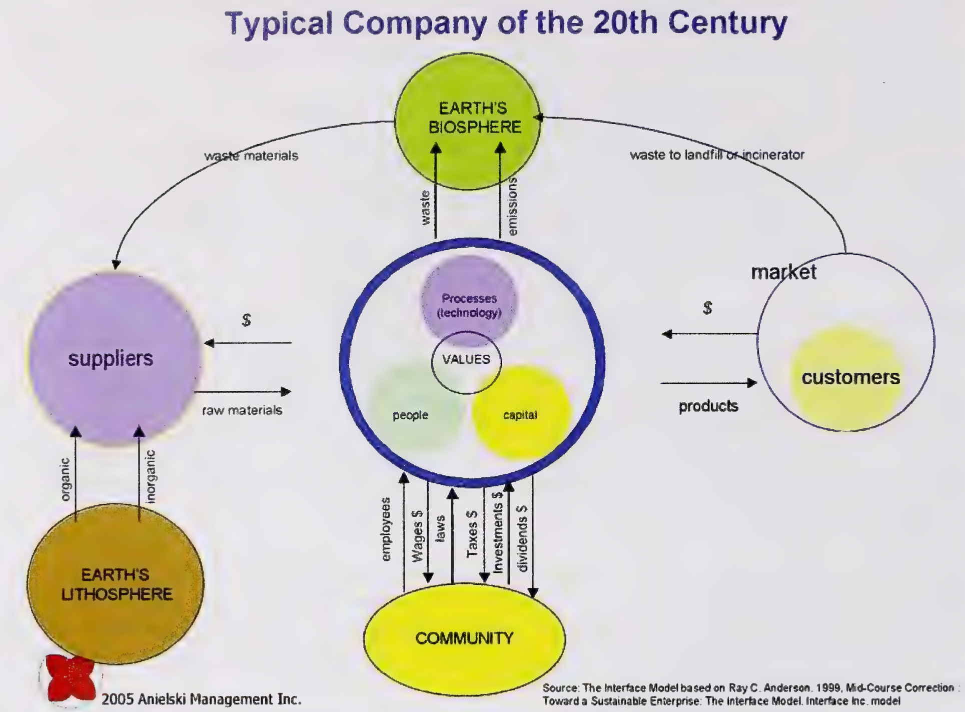
The Genuine Progress Indicator (GPI) was developed to assess the various social, environmental and economic costs and unaccounted benefits associated with economic progress in the US between 1950 and 1995; it was the first indicator of its kind to measure net sustainable economic welfare at a societal scale. In 2001 researchers with a the Pembina Institute, led by economist Mark Anielski, developed a more advanced GPI, integrated five-capitals accounting framework building on the original US GPI work. Similar GPI analysis work is being conducted in Nova Scotia by Dr. Ron Colman and *GPI Atlantic*. Both the Alberta and Nova Scotia GPI research has attempted to account for a fuller range of economic, social and environmental costs and benefits in the assessment of the sustainability of specific public policy issues, the overall sustainability of the economy, as a whole, and for the assessment of changes in the overall well-being or welfare of citizens.

This kind of full-cost-benefit GPI accounting can also be used for assessing the well-being impacts and sustainability of a business enterprise, non-profit organization or for assessing the well-being impacts of public policies and programs. For the purposes of this study, the GPI methodology is used to validate the true value of the Alberta's stewardship programs to Albertans using a well-being impact and GPI full-cost-benefit accounting approach.

Applied at the enterprise level, the GPI full-cost-benefit accounting model takes a systems approach or life-cycle value accounting (LCVA) approach to mapping and measuring the many relationships an enterprise (e.g., a DAO) has with the market (citizens), operators, suppliers, the broader community of interests (e.g., employees and households, governments, community) and the environment. The goal is to account for the physical and monetary attributes of these relationships, as well as the qualitative attributes that relate to intangible such as civic pride in a clean environment from recycling efforts. The outcome of a GPI full-cost-benefit assessment is to evaluate the sustainability of the enterprise both in financial terms but also in social and environmental terms. This includes attributes such as shared responsibility over environmental stewardship, vibrant communities, and healthy relationships with "the market" many of which cannot be converted into monetary units.

The focus of a GPI assessment both on the effectiveness and efficiency (both costs and resources (e.g., material inputs and externalities, like pollution) of the enterprise or program. Ultimately, sustainable requires that both effectiveness and efficiency are achieved to ensure a long-term flourishing system. It is critical, for example, that operations are as materially and energy efficient as possible, eliminating emissions to the environment (land, air and water), using renewable energy inputs, and building strong and sustainable relationships with suppliers, customers, employees (and their households) and the community, at large.

Figure 13 provides a schematic life-cycle diagram of the typical 20th Century company showing the relationships a firm has with its many stakeholders including the environment (based on the Interface Inc. model; one of the world's largest interior carpet manufacturers). This diagram is useful for mapping out and accounting for the stocks and flows of energy and materials.

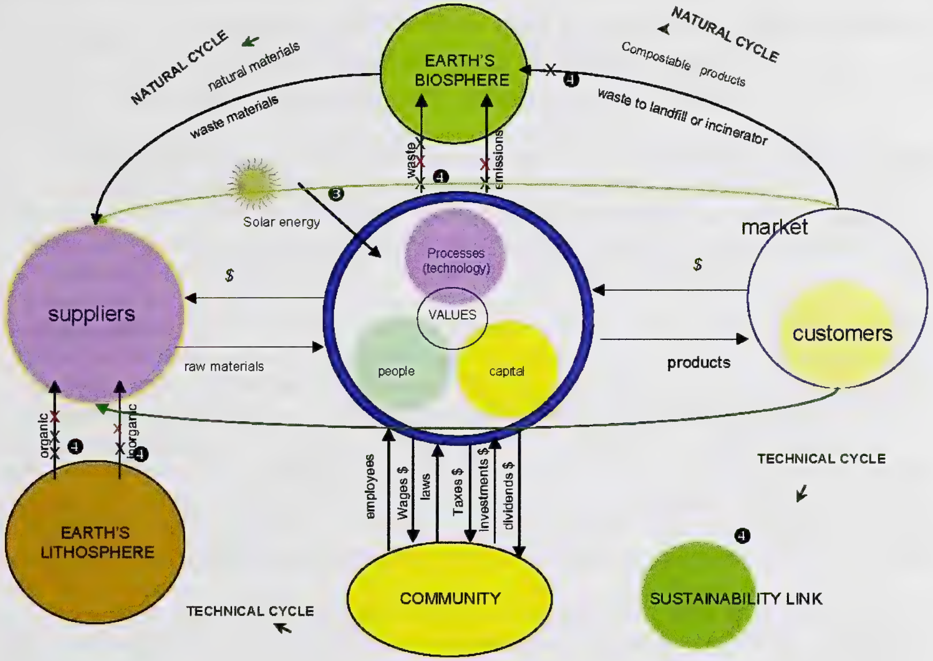


2005 Anielski Management Inc.

Source: The Interface Model based on Ray C. Anderson. 1999, Mid-Course Correction : Toward a Sustainable Enterprise: The Interface Model. Interface Inc. model

Figure 13: Typical 20th Century Company

Figure 14 shows an ideal, closed-loop, sustainable enterprise which has adopted an industrial ecology approach to its many relationships moving to a *cradle-to-cradle* or waste=food model of production internalizing the externalities of waste and moving towards sustainable energy inputs, benign production outputs, and improved relationships with its community of stakeholders.



Source: The Interface Model based on Ray C. Anderson. 1999, Mid-Course Correction : Toward a Sustainable Enterprise: The Interface Model. Interface Inc. model

Figure 14: Closing the Loop: the 21st Century Sustainable Enterprise Model

The model provides a useful framework for evaluating the progress being made towards a closed-loop system.

Appendix B: Discounting and Estimating Future, Intergenerational Beneficiaries of Waste Stewardship Program Investments

One of the key analytic tools in conventional cost-benefit analysis is measuring the discounted values of a stream of benefits and costs over the life of a project or investment. Using methods such as net present value (NPV) allows decision makers to determine whether the rate of return on capital invested is worth the initial capital outlay at a given real interest rate (net of inflation) and project discount period.

While an NPV estimate for Alberta's stewardship programs may be possible, the GPI assessment only provides a one-time cost-benefit analysis for the most recent operating year. This is partly due to the nature of both costs and benefits calculated which vary over the time period evaluated. To calculate a discounted net present value estimate for any given program would require a clear accounting of the initial capital costs and their distribution amongst the various players in the recycling sector plus a stable operating environment where operating costs and benefits are relatively constant or stable. It also requires defining a reasonable discount rate and a discount period over which the investments can be evaluated. These are complex issues to sort out.

The general rule of NPV calculus is that a potential investment project should be undertaken if the present value of all cash inflows minus the present value of all cash outflows (which equals the net present value) is greater than zero. A key input into the NPV calculation is the interest rate or "discount rate" which is used to discount future cash flows to their present values. The discount rate is the value used in accounting procedures to determine the present value of future cash flows arising from a project, that is, the discounted value of all future cash flows. If the discount rate is equal to the shareholder's required rate of return, any NPV > 0 means that the required return has been exceeded, and the shareholders will expect an additional profit that has a present value equal to the NPV. Thus if the goal of the enterprise is to maximize shareholders' wealth, managers should undertake all projects that have an NPV > 0, or if two projects are mutually exclusive, they should choose the one with the highest positive NPV.

Discount rates often vary according to the type of project, the future stream of cash flows expected from the project and whether the project is a private sector or public investment. Typically, when evaluating a private sector investment or project, the discount rate is arrived at by beginning with the appropriate interest rate of 8-12% for the length of time in question, then adding an additional sum to account for risk. One common rule of thumb is that the discount rate on stocks that has been calculated from historical data is about equal to the 10 year treasury yield plus about 6% (which is known as the equity premium); currently this would amount to a 11% discount rate in the US. Many analysts like using 15% because it means that even if the analysts are overly optimistic, the stock still has a bit of a cushion and can sell to the 11% crowd. Normally, investors add 15% to term-specific risk-free rates and another 10 to 15% for start-up projects. Discount rates of 25% till 40% are thus very common, especially for start-up projects. In practice, the discount rate used will vary from project to project, and will likely vary for cash flows of different maturities when valuing the same project.

In the evaluation of public policies or programs where benefits accrue to citizens at large, the appropriate social discount rate to use will vary under various circumstances. In the case of public investments the returns are economic in nature; that is, their benefits accrue to the well-being of the households of a community. A social discount rate is often used in public sector investment decisions reflecting the amount of consumption opportunities (i.e., taxes) that a household(s) are willing to give up to have governments participate or invest in on their behalf. Alternatively, it is the economic return on a certain project in contrast with the financial return measures such as ROI (return on investment), and interest rate. The social discount rate measures the return on a certain project from economic opportunities, taking into account the direct and indirect externalities; direct externalities related to financial aspects such as accounting profits, and indirect externalities like pollution, abatement rate, forest or other environmental damages.

When evaluating publicly funded projects the key issues are the appropriate discount rate and discount period. For example, in assessing the impact of very long-term phenomena such as planting a forest (a potential 100 year investment in Alberta) or investments in mitigating climate change impacts (perhaps a 200 year or more investment period), use of any discount rate much more than 1% per annum renders long-term damage of negligible importance now, and therefore entails (implausibly) that there is no need to take preventative action. Using very low discount rates in assessing investments in the environment (natural capital) or communities (e.g., social capital) is also referred to as a social discount rate. There is a history of debate in economic literature over appropriate social discount rates. In practice, discount rates such as 2%, 3%, 5% and 10% are widely used in economics. A typical social discount rate used in public policy analysis is 4%. There is little consensus on what value is appropriate in any given circumstance, and yet it often makes a significant difference to how an investment is viewed. The choice also depends on how much risk is involved in the investment. In general lower interest rates (and even negative interest rates) imply a higher net present value for long-term investments, which may have long-term, intergenerational well-being benefits. Lower interest rates may be best suited to investments such as Alberta's stewardship programs where benefits accrue over long periods of time and over many generations of citizens. Conversely, governments can and do take a short-term view of things, effectively applying high discount rates on the grounds that anything they do or fail to do during their mandate which has detrimental effects beyond their electoral mandate won't prevent their re-election sooner than that. The bottom line is that the choice of a discount rate depends on the expectations of the investors or stakeholders for financial, environmental and social returns on their investment.

Determining the discounted NPVs of Alberta's recycling and stewardship programs would be complex. First, because Alberta's stewardship programs are part private and part public sector investments, the choice of discount rates and discount periods will depend on the expected "returns" by each party. It is also difficult to determine and sort out the distribution of initial capital costs of the program start-up (i.e., infrastructure) incurred by both the recycling industry, governments and the DAO. Further complications arise from the fact that some recycling businesses (e.g., EcoStations) may have part of their capital investment costs partially subsidized. From the perspective of a private recycling enterprise, the discount rate is likely to be higher and the discount period shorter than if the government or public sector runs the operation; the rationale is that an investor in the recycling industry may seek a return at least as good as his or her second best alternative investment option. Second, it is not clear what the discount period should be; that is, what is the effective life of a stewardship program? What does "success" look like? This depends on the circumstances of each product being recycled, the expectations for program success and possibly the expectation of program "sunsets" once recycling markets have become self-sufficient without government intervention or support. These complexities make the estimation of either private sector or economic returns to Albertans from these programs very difficult.

We recommend, instead, that analysts focus on future changes in the annual net marginal benefits (costs) profile of each program beginning with this initial GPI assessment as a benchmark. This would allow annual "returns to societal well-being" to be evaluated regularly while considering both operating and capital costs as well as the other related benefits and costs that we have evaluated.

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